THE MODEL ENGINEER

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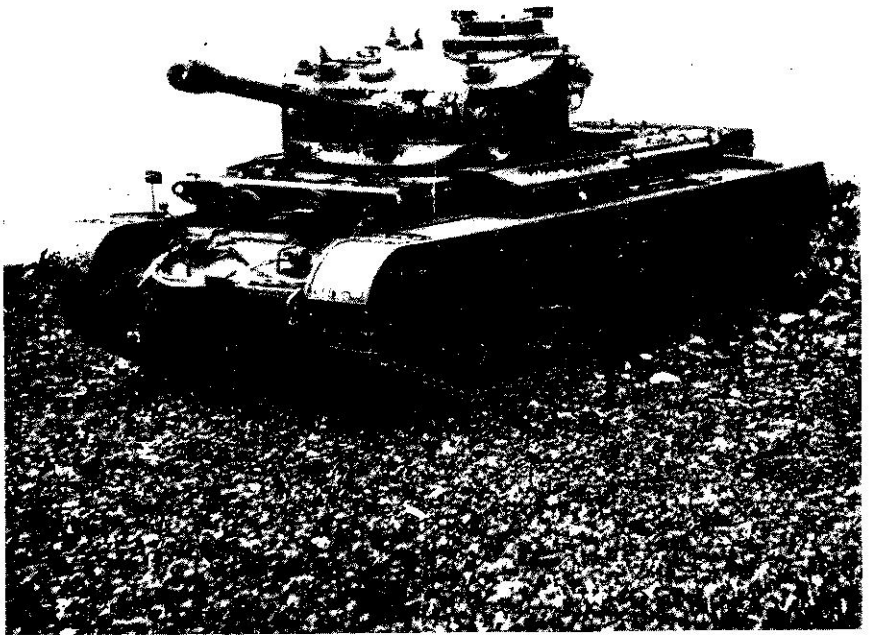

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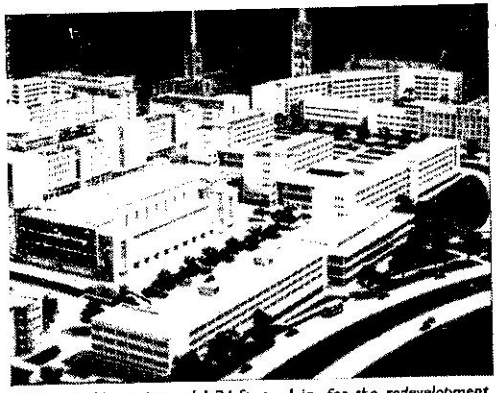

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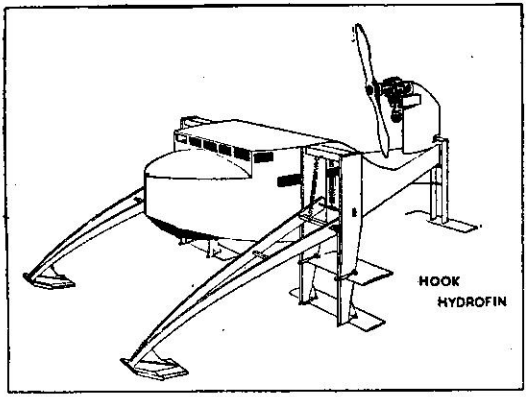

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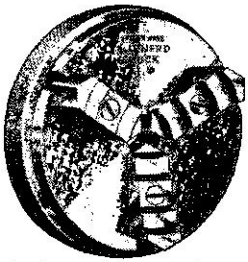

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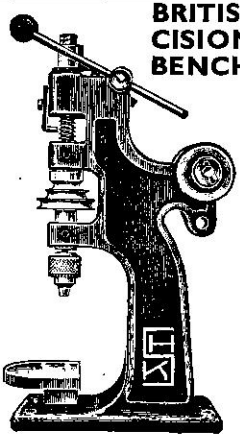

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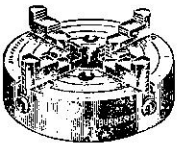

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THE MODEL ENGINEER

Vol. 94 No. 2330 Percival Marshall & Co., Limited Cordwallis Works, Maidenhead January 3rd, 1946

Smoke Rings

A Gude New Year

THE ancestral but still perceptible Scottish blood which courses through my veins inspires me to wish all my readers North of the Tweed the happiest of New Years. Not that I would debar the Southrons from a share of the good things which we all hope 1946 will bring us, but I know how bright is the star of model engineering in both the lowlands and the highlands of the North, and I wish its followers everything that is good. If I cannot " first foot " them in fact, or toast them in their almost unobtainable native spirit, I can at least blow a " Smoke Ring " of goodwill towards them, and this is it.

Signs of Springtime

WHEN the soft airs of spring approach we observe the buds and little green shoots on our plants and trees which give promise of glorious foliage and blossoms yet to come. If you study this issue of THE MODEL ENGINEER you will notice some little buds of print and paper. By a modest relaxation of the restrictions of paper control we are enabled to add another four pages to our weekly issues. It will be observed that these are occupied by advertisements, which we hope will open the door to an increased supply of goods and services to the mutual benefit of our readers and the trade. For a long time past we have been compelled to limit our acceptance of advertisements to the three cover pages, a restriction which has much hampered our trade friends in their efforts to get the wheels of business revolving again, and our readers in getting the goods they need. That is bud number one, which we hope will be a welcome indication of business flowers to follow. Our small allowance of extra paper is also being applied to increasing the number of copies we can print each week. This will ease the difficulty which so many readers have felt in obtaining their MODEL ENGINEER with regularity, and there should now be no difficulty in obtaining the journal if a standing order is placed with a newsagent. The circulation of THE MODEL ENGINEER has been like a spring in compression, always striving to expand but kept in check by the retaining shackle of paper control. The loosening of this shackle is bud number two on the healthy MODEL ENGINEER tree. There is yet another sign this week of the rising of the sap. A change in the type used in our editorial pages enables us to increase the matter per issue by about twenty-five per cent. The new type, though slightly smaller in face, is extremely legible, and will, we hope be found just as easy to read as the type previously used. These are all indications that THE MODEL ENGINEER is beginning to burst into leaf again, and given the sunshine of further relaxation of official control, the model engineer's tree of life will in due course bear an even more luxuriant foliage of the instructive and entertaining knowledge which gladdens the eyes and the hearts of its thousands of readers.

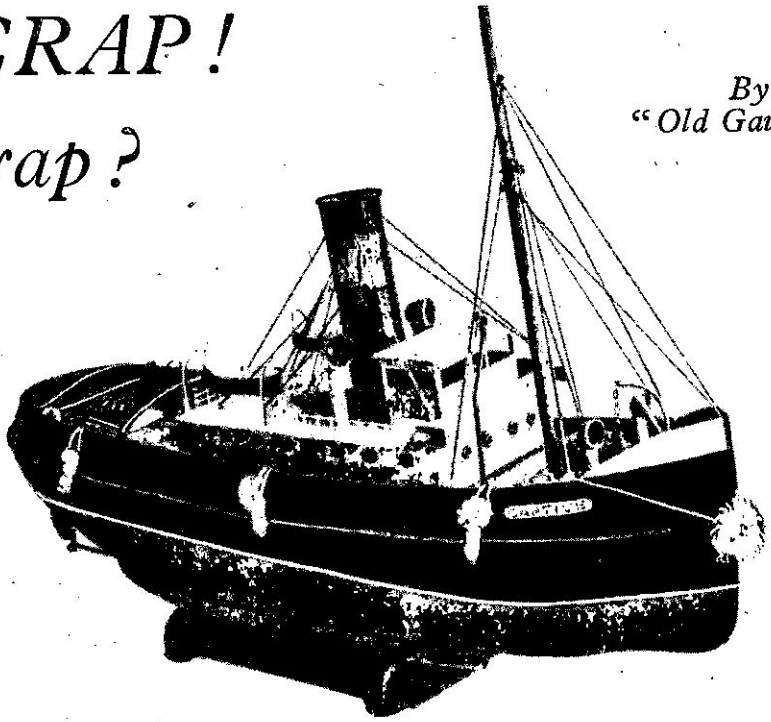
Larger Locomotives

I THINK many of my readers must have observed with interest the growing tendency to build " live steam " locomotives in the larger gauges. Many enthusiasts start off with a ½-in. scale job and experience for the first time the thrill of passenger hauling, even with a limited load. The appetite is whetted, and with the desire for more power, more comfort in driving, and for greater passenger capacity, a larger job is planned and eventually built. This naturally calls for appropriate workshop equipment and skill, and for a longer and more substantial track if the engine is to show its paces to advantage, but the reward is great when steam is turned on. The trend towards larger scales is equally evident in the United States, as I learn in a letter from that enthusiastic " live steamer " the Revd. John D. Mahar, S.S. of St. Charles' College, Catonville, Maryland. He writes : " I am still plugging away on my ¾-in. scale job of the Pennsy 4-6-0 and getting out details for the B. & O. articulated 2-6-6-2. Other members of the ' crew ' are making patterns and necessary jigs and fixtures for these models, as interest in the ' Live Steam ' end of miniature railroading is running high. The paper work will take up our time until we get a ' clear block ' on supplies. A recent poll taken by a few of the representatives of ' Live Steam ' seem to show a decided tendency to the larger scales. The half-inch scale in some sections has given way to the ¾-in. scale and in a few instances the ¾-in. scale has made way for the 1-in. scale, and even the 1½-in. scale. A 1½-in. scale job of our 2-6-6-2 would measure about 8 ft. long, 15 in. wide, and almost 24 in. high, a nice-sized job for anyone."

Percival Marshall

SCRAP! Scrap?

By "Old Gaumless"



The finished model, 24 in. long.

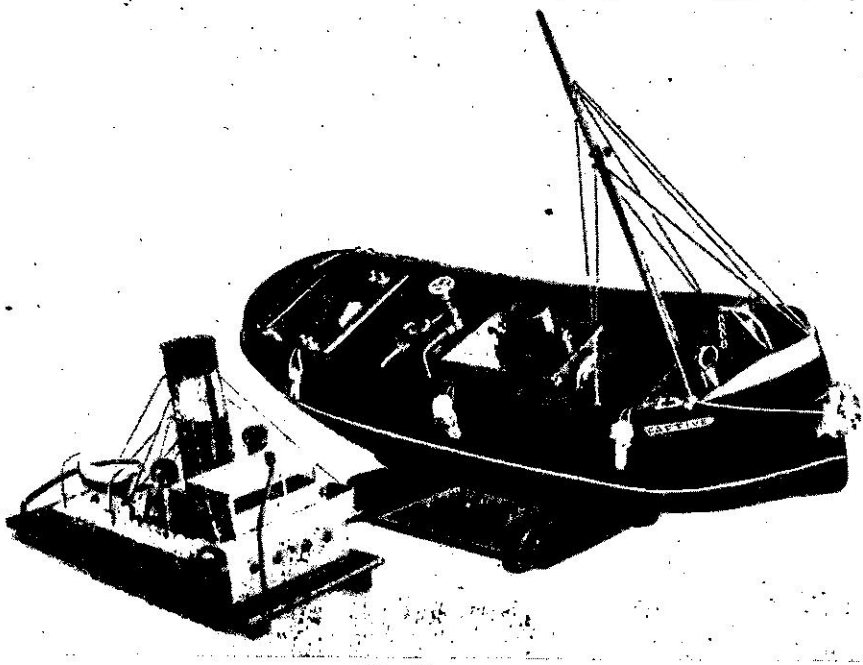
SOME three years ago, during the worst period of "short supply" that I have ever experienced during the war, a friend gave me a lump of wood. Yellow pine with a straight grain and no knots, it had only one fault. It was too short in relation to its width and depth. It was a most welcome gift, however, because it enabled me to make a start upon another model ship which had been promised to a youngster many months before.

To waste any of this lovely wood was a pity and, as an accurate scale model would have meant just this, a search through the shipping books was instituted to find out just what particular prototype could be copied with the minimum amount of waste. The tug *Wellington* was finally decided upon as, being rather short and squat, a certain amount of length could be sacrificed in the model without any pronounced affront to the experienced eye. The first photograph illustrates the completed model, so that readers may be able to form their own judgment upon this point and upon the general appearance also.

Dimensions of the hull are 24 in. long by 6 in. beam by 5 in. depth, and, in accordance with my usual practice, it was carved from the solid. The shape and contours of each side were constantly checked during carving, by the use of hard lead strips. To me, this has always proved the easiest and quickest way of making certain that both sides of the hull are alike. When one side of the hull has been satisfactorily carved, a number of vertical lines are pencilled equidistantly along the whole length of that side. A strip of hard lead is then gently beaten down upon each line in turn, thus forming a template or gauge for the shape of the other side. This is not by any means a new method, as other articles in THE MODEL ENGINEER have described the same idea.

An old "pot" boiler was rescued from the scrapbox, re-soldered, and fitted with a safety-valve, stop-valve, filler and level plugs. The spirit-lamp is of the ordinary wire-mesh, vaporising type, holding about 1½ ozs. of spirit, sufficient for about 20 minutes' run. The engine is a ⅝-in. × ⅝-in. double-acting oscillator, a new design of "Gaumless Junior's" which we were then trying out. Exhaust steam is led out two ways, i.e. up the funnel and through a bilge-hole. Propeller is of the three-bladed pattern, the blades being silver-soldered into a turned boss. Shaft is ⅛-in. stainless steel, and the flexible couplings are of the two-pin-and-slot type. Rudder is sheet brass, brazed on to a bronze post and is controlled by friction alone, as there was no place for a quadrant on deck. The second photograph shows the general layout.

Superstructure was cut out from thin tinplate, built up with soft solder, the port-holes being shoemaker's eyelets; rigging in fishing line; and the tow-rope bridges made from some old 2½-in. gauge rails. Funnels in tinplate with two

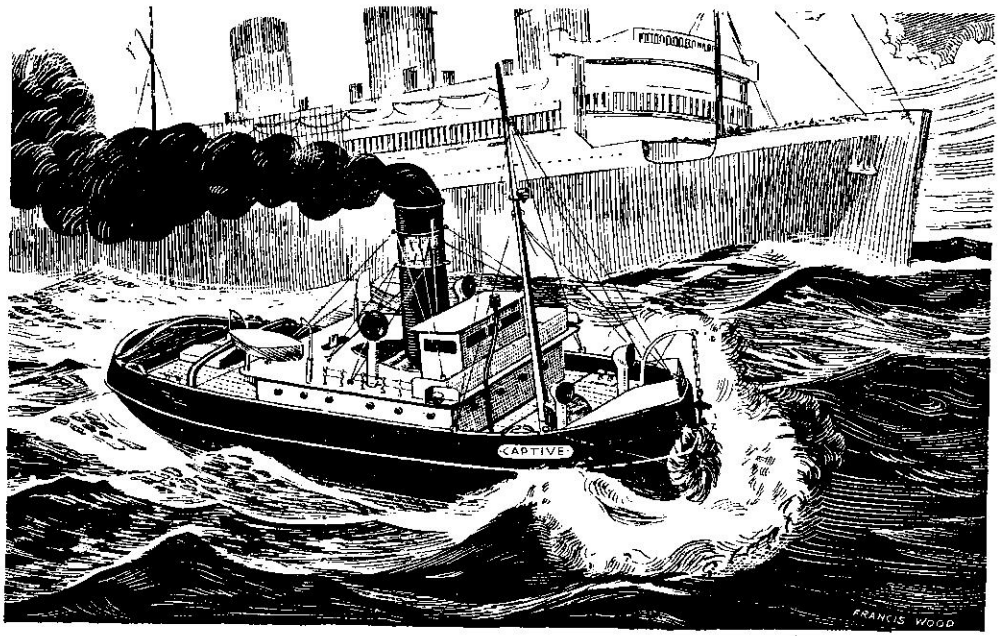


The "innards"

copper rings and a polished brass "W" sweated on, this latter being the owner's distinguishing mark.

Decks are in 3-ply, the removable centre portion being lined underneath with a heat protector in the form of thin sheet iron. Lining, to imitate planking, was done with indian ink and a draughtsman's pen, a coat of thin carriage-varnish being applied as a preservative and water-proofing agent. Ventilators are of cast babbitt; the lifeboats carved from chippings left over from

(*Continued on page 7*)



A CONGREVE CLOCK

By Dr. J. Bradbury Winter

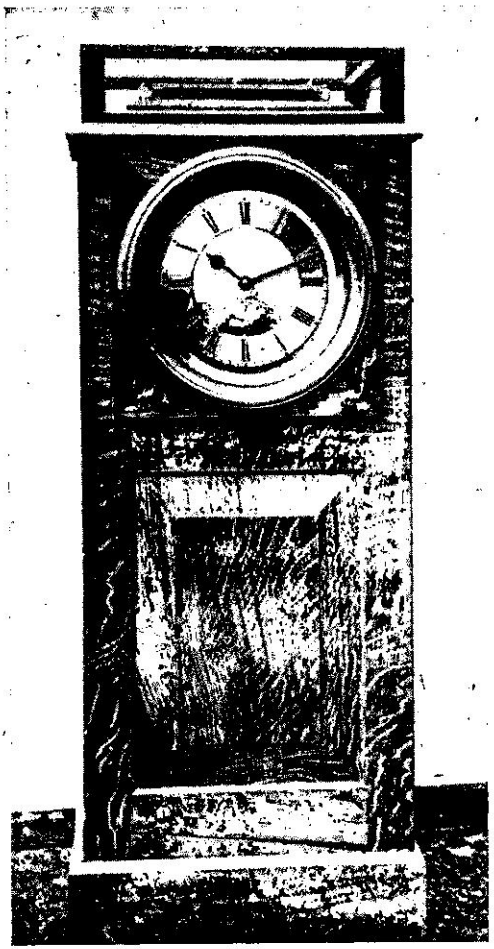
Details, dimensions and instructions for making an attractive timepiece

IN response to a request from many readers for full details of the clock described in the issue of THE MODEL ENGINEER for October 18th, 1945, the Editor has asked for these to be made available. Mr. Stephens made this clock entirely from my designs and under my personal supervision, and he now asks me to take over the responsibility of broadcasting to interested readers.

To prevent disappointment, let me warn prospective builders that this method of time-keeping cannot possibly compare with a pendulum; its only claim is that it is spectacular. In order that it should be a useful time-piece it is absolutely essential to synchronise it with some other clock of more orthodox construction. The synchronising mechanism will be included in these articles.

After this warning, let me add a note of encouragement. This clock was Mr. Stephens' first attempt at any serious mechanical construction. He bought a 3½-in. Myford lathe expressly for it, but had no knowledge whatever as to how to use it. That he has turned out such a first-class job in eighteen months of spare time, must surely go to prove that the undertaking is not beyond the capacity of the average model engineer.

As mentioned in the previous article, the rocking-plate is the first consideration. Procure a piece of sheet-brass about 9 in. square by 5/32 in. thick, flattened and planished. It should be sawn out, not sheared. Straighten one edge.



Mr. J. W. Stephen's completed Congreve clock

Referring to the photograph of the rocking-plate in the October 18th issue, cut out the two side pieces and seven triangles from 3/32-in. sheet-brass, as flat as possible, and accurate to the dimensions given in Fig. 1 of the present issue. Note that the ends of the side pieces are exactly square with their outside edges, but the triangles are isosceles. All the edges must be dead straight and polished with a No. 3 or No. 2 emery stick; they must also be square with the surface.

To begin with, the triangles are cut out 1/64 in. longer than the side pieces, measured from the centre of the base to the flattened apex. The apex, which is 1/32 in. wide, is then lightly rounded with a dead smooth file, leaving the triangle 7 61/64 in. long on its centre line, with a rounded tip having a theoretical radius of 1/64 in. I say "theoretical" because, in fact, it will be just rounded to eye.

Now take the side piece which is at the bottom of the photograph; clean its under surface and tin it. Lay it on the plate with its outer edge flush with the finished edge of the plate, and central as to length. Put on two cramps. The cramps used were of standard pattern, though home-made (see Fig. 2). When it comes to the turn of the triangles to be fixed, the cramps can be turned round with their usual business ends beyond the ends of the plate, and a piece of metal, say, 5/16 or ⅜-in. round rod, inserted for the jaws to bite on, while the tightening

screw pinches down on a piece of sheet-metal placed between its point and the triangle; this will give it a longer reach.

Solder the outside piece on the plate; leave it to cool till below boiling point; scrub with soap and water and finally rinse under the tap. Drill two holes, a good fit for 3/32-in. brass rod, slightly countersink and rivet flush. Run a file along the straight edge of the plate to remove any outside piece, if the tin is just loose between the other blade and the apex, it may pass; but, if there is a gross slackness, the triangle must be scrapped. So I repeat, go slow and very carefully.

Tin the under surface of the triangle. Cramp it on the plate with the cramps reversed and the distance pieces in place, and its base dead in line with the end of the outside piece. Remove the distance pieces and solder as before. Scrub with

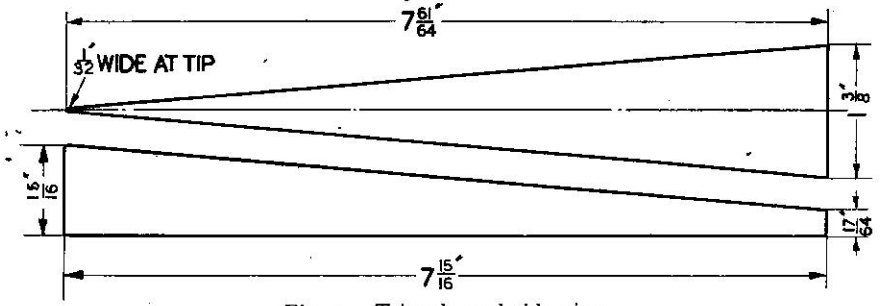


Fig. 1. Triangle and side piece

slight discrepancies between the edges of the plate and outside piece, and clean off all solder at the other edges of the outside piece. This is best done with a piece of copper wire about $\frac{1}{8}$ in. diameter, shaped at one end like a screwdriver or cold chisel by hammering and filing; the hammering will harden the copper. The other end may be pushed into a wooden handle, or merely bent round to form an eye for the hand to grip. With this tool there is no fear of cutting the brass; any kind of steel tool would be dangerous.

Prepare two distance pieces of sheet or strip metal, say, $\frac{1}{2}$ in. long and exactly $\frac{1}{16}$ in. wide; also a small bit of tin 1/64 in. thick. Place one of the triangles on the plate, with the two distance pieces between it and the outside piece. Put a square against the finished edge of the plate with the blade brought up against the wider end of the outside piece. Slide the triangle along until its

soap when cool and rinse. Rivet as before and clean off all solder.

Repeat exactly for each of the six remaining triangles and the other outside piece. If the blade is not long enough to reach the farthest triangles, substitute a steel rule.

As we started with the plate 9 in. square and the finished distance over the two outside pieces is round about $8\frac{3}{4}$ in. (depending on just how much the 9 pieces plus 8 grooves add up to) there will be a small margin beyond the side piece which can now be sawn off and finished by filing flush. This over-all dimension is of no importance, but the length of the plate is of the greatest importance. Eventually it will have two end pieces ("AA" Fig. 3), bringing the over-all dimension to precisely $9\frac{1}{8}$ in. These end pieces are of brass strip $\frac{9}{16}$ in. × $\frac{1}{8}$ in., but as the outside surfaces must be polished, they will probably be

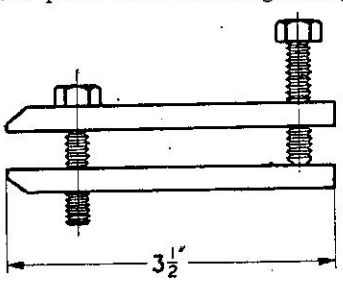


Fig. 2. Cramp

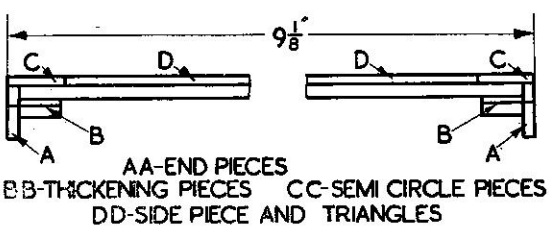


Fig. 3

rounded tip pinches the bit of tin against the blade. The base of the triangle will now project slightly beyond the other end of the outside piece. This base must be very carefully filed away until the blade of another square shows that they are perfectly in line. The help of an assistant to hold some of the objects during this operation will be very welcome. Nothing is ever perfect, but the tolerance here can only be very small; with the base of the triangle against the blade touching the

a shade under $\frac{1}{8}$ in. when finished. It will be wise therefore to file the plate now to a shade full of $8\frac{7}{8}$ in.; "a shade" here means about 1/128 in. Obviously the margin beyond the bases of the triangles must be the same at each end.

A recess has to be cut out in that end of the plate where the grooves terminate, to accommodate the electrical wires going to the inner side of the terminal inclines (see Fig. 5). If the recess is $\frac{1}{8}$ in. deep, it will give ample space for ordinary

insulated bell wire ; it must not be deeper or it would come too close to the semi-circular recesses. The length of the recess must extend as far as the inner edge of the terminal groove, say, $\frac{9}{16}$ in., from the edge of the plate.

We now have to make the two pieces with semi-circular recesses to join up the grooves (see October 18th issue). I have said that the points of the triangles are theoretically semi-circles of 1/64 in. radius. The bit of tin was 1/64 in. thick ; therefore the centre of the curve is 1/32 in. from the line along the bases of the triangles, and it is from that centre that the semi-circular recesses should be struck. It would be impracticable to rest a leg of the compasses on such a tiny surface, and even if it could be done it would damage the tip of the triangle. What is wanted is a centre-pop for the compasses 1/32 in. off the edge of the strip we are about to make ; this is provided by cutting the strip too wide to begin with.

From the same sheet-brass that was used for the triangles, saw two strips a little longer than the breadth of the plate and about $\frac{3}{4}$ in. wide. File one edge straight. Scribe two lines on it parallel with this edge, 1/32 in. and $\frac{1}{16}$ in. from it. This is best done with a scribing block if you have one.

Lay the strip on the plate with its trued edge touching the bases of the triangles and fix it with a couple of cramps. Scribe lines on it crossing the existing lines, and exactly corresponding with the tips of the triangles. Make small centre-pops at the intersection of these lines with the line 1/32 in. from the edge. Set the compasses to the far side of the grooves and describe semi-circles.

Remove the strips and file out the recesses. When getting near the compass lines, keep on offering the strip against the grooves to ensure exact correspondence. Allow a tiny amount for polishing. This may be done with a lead lap in the lathe, or a piece of metal rod may be turned in the lathe to a diameter slightly less than that of the recesses ; the work is then held in the vice, and a strip of emery paper is pulled backwards and forwards by an assistant while the rod is held pressing it into the recesses. Note, emery-paper is better than cloth.

The brass strips can now be filed down to the inner line $\frac{1}{16}$ in. from the edge and may be tinned ready for soldering, but firstly the two thickening pieces which pass across the underneath of the plate must be made. These are brass strip $\frac{7}{16}$ in. × $\frac{5}{16}$ in. and are tapered to $\frac{1}{16}$ in. thickness at their ends (see Figs. 3 and 4). They should be left a little too long, to be trimmed off flush with the plate after fixing. The top outside edge of the right-hand thickening piece must be bevelled for about an inch at the centre to enable the wires to enter the recess in the end of the plate, as indicated in the drawing. It is important not to overlook this point ; it would be a troublesome job to rectify the omission after the piece was soldered and riveted to the plate.

Place one of the semi-circle pieces on the plate and one of the thickening pieces underneath, the former lying against the bases of the triangles, while the latter is flush with the end of the plate (see Fig. 3). Put the cramps on lightly, tap the two pieces into eaxct position and then tighten the cramps. Solder both pieces to the plate and finally rivet them with two pieces of rod passing through all three. The position of the rivets should be about opposite the centre of the bases of the two outer triangles and far enough from the end of the plate to clear the recess for the electrical wires.

The two end pieces (Figs. 3 and 4) can now be made, either from brass strip or cut from sheet $\frac{1}{8}$ in. thick. As always, leave them a shade too

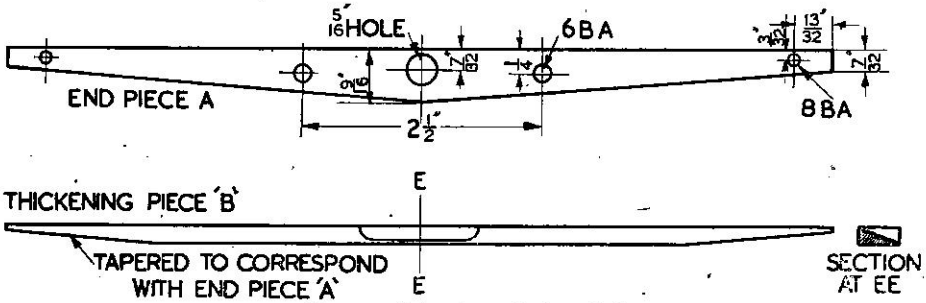


Fig. 4. Side views of A and B

long, to be flushed off after fixing. They are held by four screws, those near the middle being 6-B.A., while the outer ones are 8-B.A. The heads are of the "raised" type, i.e. ordinary countersunk pattern, but instead of being flat at the top they are slightly rounded. The two middle ones screw into the thickening piece, but the outer ones are tapped into the rocking-plate. May I be excused if I give a caution against breaking the tap off short in the plate ! There is a $\frac{5}{16}$-in. hole in the end pieces, exactly halfway across the plate, to take the steel trunnions on which the plate rocks ; the holes may be drilled, but the trunnions will be made later.

The unfinished overlapping edges of the semi-circle pieces can now be filed off flush with the end pieces, but the "raised" screws would get in the way. For this operation, therefore, the end pieces should be temporarily secured with ordinary countersunk screws whose heads can be filed flush with the surface, the "raised" screws being kept for the finished plate. After filing flush, the end pieces and edge of the semi-circle pieces can be polished with emery sticks. The ends of these pieces can also be filed flush and polished at this stage. Make sure that the over-all length is precisely $9\frac{1}{8}$ in.

The top surface of the rocking-plate (that is to

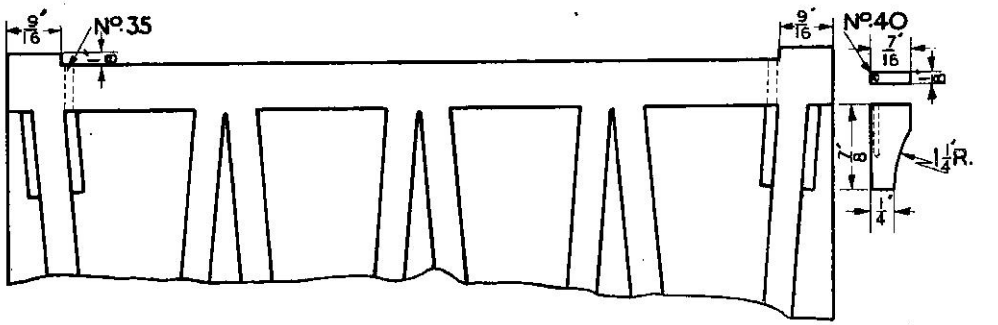


Fig. 5. Plan of rocking-plate, showing recess for wires and holes leading to terminal slots

say, the triangles and other pieces forming this surface) is now to be filed flat and polished. Take a new fine-cut file, say, 12-in., without a handle, and embed it in a shallow frame like the lid of a box made of plywood, with some sort of a handle on the top like a carpenter's jack plane. Rub this over the plate, in all directions until it is flat. Then use emery sticks in the same way to polish, but not going down finer than No. 3 at this stage, the finer grades can wait till later. Of course, as in all polishing, it must be "straight grain," that is to say, the emery sticks must finally be rubbed longitudinally on the plate, always in the same direction.

To complete the plate, the terminal inclines (Fig. 5) must be made and fixed. They are cut from $\frac{1}{8}$-in. sheet or strip, and are let into slots cut in the plate, as seen in the photograph in the October 18th issue. It will be noted that in each pair, the outside incline will be somewhat longer than its fellow, because they start rising from the plate on a line at right-angles to the groove, whilst ending on the line of the bases of the triangles; this end, moreover, is not at right-angles to the axis, but corresponds to the angle between the groove and the end of the plate.

The slots must be cut with great care, so that the inside edges of the inclines continue the line of the grooves accurately. The outer incline is a nice fit in the slot, tight enough to keep in position while being soldered. If it is left a shade too deep, it can easily be filed off flush with the under surface of the plate after soldering.

The slot for the inner incline is cut a little bigger to allow for a thickness of paper all round. This is fixed smoothly on the incline with one of the many kinds of adhesive materials now on the market. We used a preparation called "Croid." After allowing time for it to dry, the slot is cut to fit and another application of croid glues the incline to the plate. It will be noted from the drawing that a hole (No. 40) is drilled to a depth of $\frac{1}{2}$ in. or so from the end of the inner terminal; this is to take the end of the electric wire which makes contact by means of a steel spring to be described later.

Before fixing the inner terminal into the slot, a No. 35 hole must be drilled from the end of the recess in the plate to correspond with the hole in the incline. As the hole in the plate is larger than the one in the incline, it will allow for any slight discrepancy in alignment between them. The wire will come along the recess in the plate, turning sharply at right-angles to pass into the hole, and so into the terminal incline. The sharp edge of the hole should be chamfered with a graver to avoid risk of injury to the insulation on the wire.

Since the insulating paper was wrapped right round the incline, it will have covered the hole. After fixing in the plate and allowing time for the croid to set, the paper can be perforated with any pointed instrument, but on no account use a drill. We made this mistake. The drill cut a tiny shaving of brass which destroyed the insulation by bridging across from the incline to the plate. This occurred in each case and necessitated removal of both inside inclines.

After fixing, test with a voltmeter or torch bulb to see that the incline is insulated from the plate.

The final polishing of the plate may now be done. There is no need to do anything to the under surface, as it is not seen.

(*To be continued*)

SCRAP! Scrap?

(*Continued from page 3*)

the carving; davits in $\frac{1}{10}$-in. brass wire; anchor davit in $\frac{1}{8}$-in. ditto; galley funnel in $\frac{1}{8}$-in. copper tube; port and starboard lights are shoemaker's "hooks" (the top three holes on the old-fashioned boot); and, finally, the "fenders" are pieces of old clothes-cord whipped with cotton.

Colours are red, amber and black, those of the Bradford Sports Clubs, and that may give other county "fans" an idea for their own colour schemes. Sort of signature-tune!

The model has just been returned to me for minor repairs and I am more than satisfied with the performance of the engine and the condition of the superfine enamel, as neither of them show any serious signs of age. When the repairs were finished, I took the opportunity to have the model photographed, hence this article.

In conclusion, I would like to refer to the splendid black-and-white sketch which is reproduced on page 3. A rather well-known commercial artist presented me with the original as a little gesture of acknowledgment for the making of the model for his small son and, before framing it, I just had to share it with all the other readers of THE MODEL ENGINEER.

* *The Problem of Efficiency in*

SMALL STEAM TURBINES

By J. H. JOHNSON, F.C.I.S.

The nature of the losses and their reduction. Can progress be made by reversion to low-pressure steam?

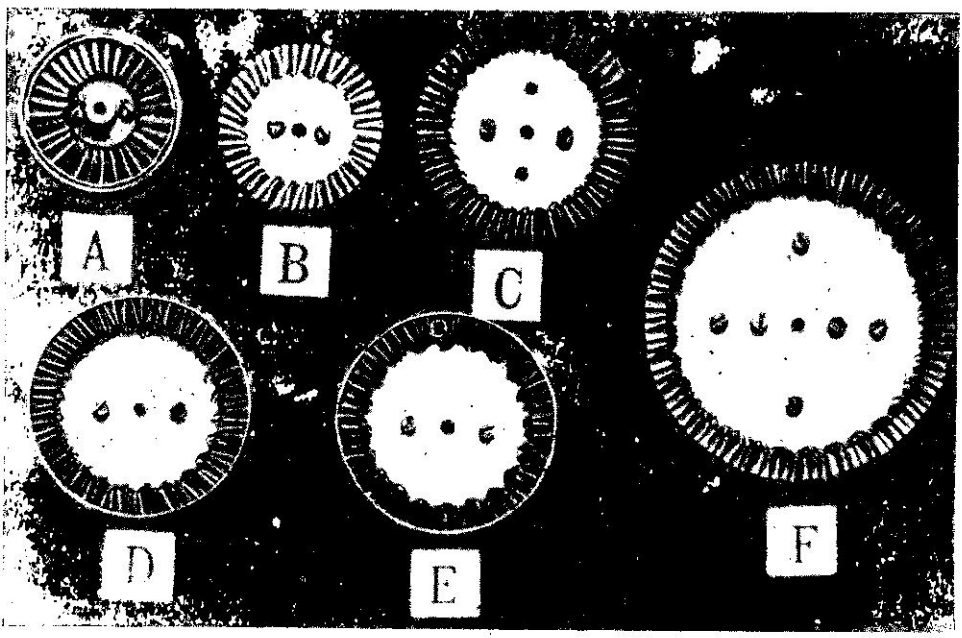
WHAT, in effect, have I, and others, been doing up to now? Make no mistake about it, we have been merely wasting the boiler's valuable time! We have been making it hold the steam for a comparatively long time, while it acquired extra heat and higher pressure which we could not use effectively. The boiler has been unnecessarily strong and heavy, wasting some of our heat in unnecessary heating of an undue quantity of copper, when a lighter boiler, of much thinner material, transferring the heat to the water and steam much more quickly, would have served our purpose better.

What is the main object of staging in large turbines? To reduce the velocity of the steam, so that it can be used more effectively at its most efficient blade speed. If it is desirable in a large turbine, how much more necessary it is is a small one, and steam follows the laws of nature in small quantities exactly as it does in large. Why should the model engineer bother about staging, so far as blade velocity is concerned, when he is using, say, 1 blade in 60 on his rotor, and therefore has 59 others through which he can push steam at lower pressure and with lower velocity?

Oh yes! We shall use bigger quantities of water, needing a bigger feed pump, or running the pump faster; but it will be feeding against a much lower pressure, and if the turbine gains in efficiency, we shall have more power to spare. A measure of superheating, especially if obtained from what otherwise might be waste heat, will help. If a suitable condenser scheme can be evolved, we can use the same water, or most of it, over and over again, and have warm feed-water, while the condenser will give us still bigger quantities of steam, or improved velocity in the steam, dependent upon the vacuum. Is the picture too rosy? It may be; we shall see.

On the subject of superheating and condensing, it should be remembered that most of the heat of the steam (including superheat) is given up in adiabatic expansion in the nozzle, this being

* *Concluded from page 620, "M.E.," December 27, 1945, Vol. 93.*



Side views of experimental rotors, showing respective areas occupied by blading. A—2-in. brass, with flywheel ring; B—2⅛-in. aluminium; C—2¾-in. tin; D—2¾-in. brass, with shrouding; E—2¾-in. tin, with shrouding; F—4-in. tin, now under test

the way the potential energy of the steam, under pressure and with no velocity in the boiler, is converted into kinetic energy at negligible pressure and very high velocity at the nozzle exit; also, as the steam loses most of its heat in the nozzle, the heat carried to the condenser would be small. I hope to make a small condenser for testing purposes, from some copper tubing in hand.

Conclusion

What then, are the lines of advance? Much experiment will be necessary before the best results are achieved, and the pooling of experiences will be helpful. Why not have a Model Turbine Development Society? It would, too, be very helpful if the Model Power Boat Societies could arrange competitions for turbine-driven craft. Perhaps one or more of the large turbine manufacturers could be persuaded to put up a trophy or trophies for annual competition. Then we should see some progress made.

In the meantime, I summarise my ideas on design :—

(*a*) The steam, preferably superheated and used with a condenser, should be supplied at the pressure at which it can be used for maximum efficiency by the turbine. Note that it is not the same thing to provide steam at high pressure in the boiler, and then distribute it through several nozzles. That, again, is wasting the boiler's time. Fig. 7 is a graph showing the rotor energy as percentage of the energy available at the nozzle exit, in terms of fractional reductions in blade speed. The peculiar line taken by the graph is, of course, due to the fact that the fractional units become smaller and smaller proportions of the whole, but has special significance, as it draws attention, quite clearly, to the fact that the blade speed between one-fifth, and one-sixth of the nozzle speed is the crucial spot. We must, for reasonable efficiency, lower the velocity at which the steam is supplied so that the rotor can do its work, if possible at not less than one-fourth, but in any case at not less than one-fifth, of the nozzle velocity.

(*b*) The steam must be supplied through nozzles of the correct shape and length, to secure the utmost expansion, increase in velocity and decrease in heat. The nozzle must be longer for superheated steam. The size of nozzles can, I feel, be finally settled best by trial and error, rather than calculation. Remember the artillery-man's "bracket," first get either side of your objective; a trial in the middle soon shows you where you stand.

(*c*) The blading must be short, shrouded, and preferably the steam passages between the blades closed by a suitable run on the body of the rotor. Put the steam through a number of blades, rather than a large quantity through one, and so reduce the number of idle blades.

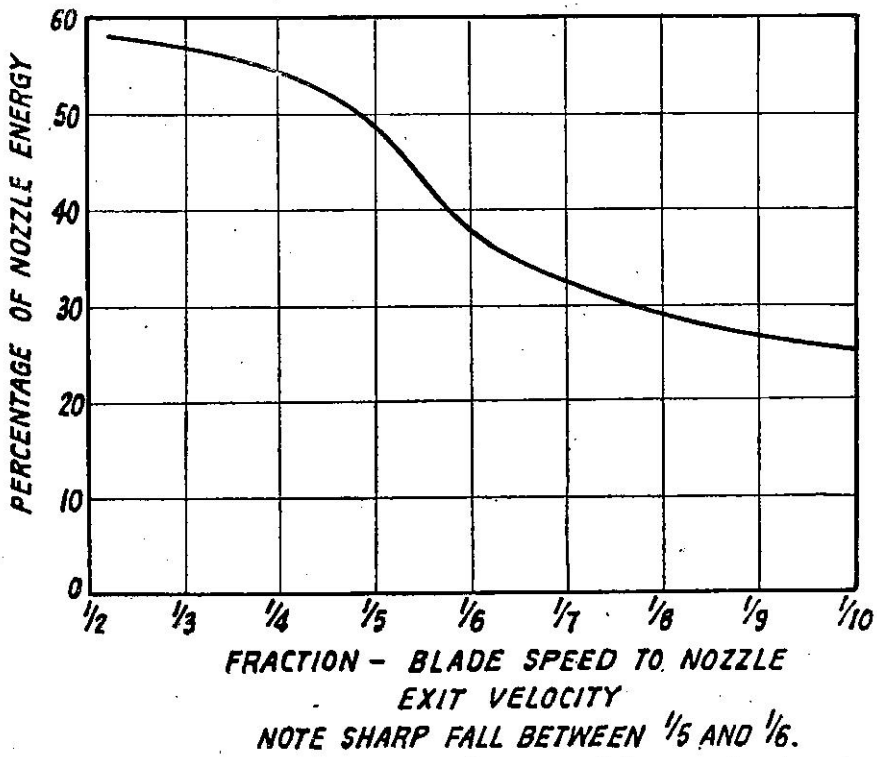


Fig. 7. Graph showing rotor energy as percentage of energy available at nozzle exit, at fractional reductions in blade speed

(*Continued on page 12*)

BED COVERS

By C. T. Bower, Int. A.M.I.P.E.

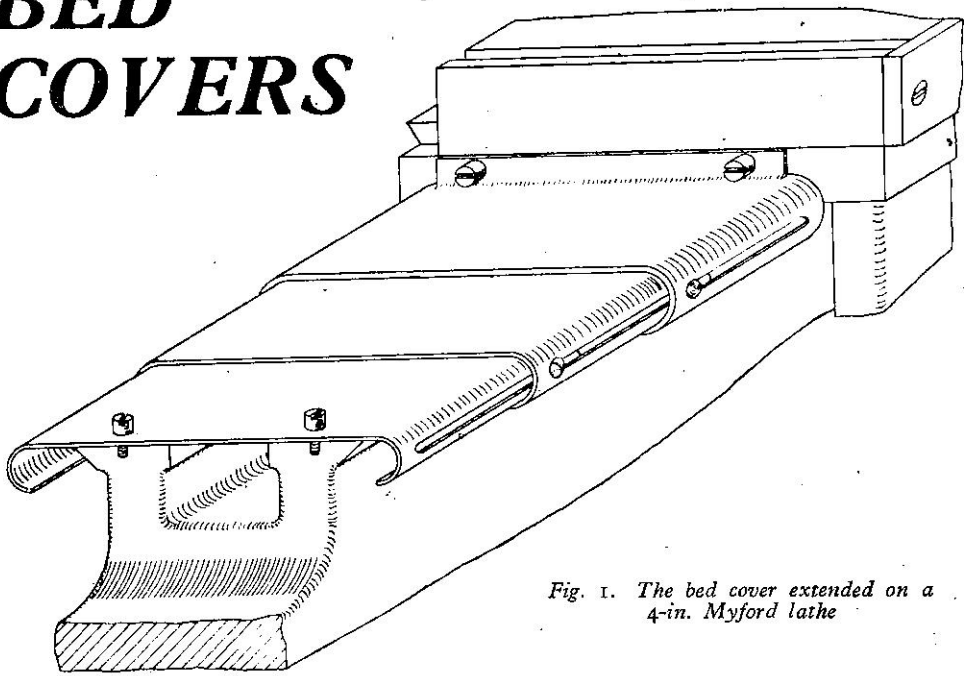


Fig. 1. The bed cover extended on a 4-in. Myford lathe

I AM one of those people who suffer acutely at the sight of ill-used machinery. A lathe-bed covered with swarf and filings produces quite a worried feeling. But laziness prevents my wiping the lathe-bed before running the saddle over it, and I suffer pangs of remorse in consequence. I am also slightly parsimonious and dislike applying lubricating-oil to the lathe-bed only to wipe it off again in the next five minutes, and apply more. So to spare my nerves, conserve my energies and save wasting oil, this telescopic lathe-bed cover has been evolved.

In the machine-tool trade, the covered bed has quite a strong selling power and many ingenious designs exist. Machine operators, however, regard them with mixed feelings owing to some poor designs which have been put out and then scrapped. The main faults of some covers have been : interference with the smooth working of the machine ; lack of durability, and, in some cases, inability to perform as swarf excluders. The "Vee" type of lathe-bed works well with cast bed covers, which are small and light and can be made of adequate length, since the Vees usually pass alongside the lathe headstock, thereby permitting the saddle to work close up to the chuck without the covers getting in the way.

In the old English type flat bed lathe which the majority of model engineers use, the bed finishes at the headstock front ; therefore, the guard must telescope into the minimum length possible. The most interesting method of obtaining 100 per cent. coverage on a flat bed that I ever saw was on the Porter Cable lathe of American manufacture. The headstock was gear-box type, the under-side being of bridge form which straddled the bed and was supported on lugs cast on the sides of the bed casting, so that a clear space was made under the headstock casting which allowed one-piece sheet-metal covers to slide under. These long covers were attached to both sides of the lathe saddle and at no time were the sliding surfaces of the bed exposed. The tailstock was kept away from these covers by being mounted on a separate set of slides on the rear vertical face of the bed casting. The saddle was traversed by a long screw running between the slides and thus also covered. Cranking of the screw was achieved by a bevel-gear drive which brought the crank into a convenient position on the front face of the bed casting. The lathe had been in service for many years in pretty rough circumstances, but the slides were perfect when the covers were removed for me to see. This lathe seemed to have been designed around those bed covers, everything else being subordinated thereto.

Having put over the idea that lathe-bed covers are desirable, here's how to make one. The cover I made for my 4-in. Myford is shown, fully extended, in Fig. 1, and in the closed position in Fig. 2. It compresses into a length of 3½ in. when closed and is about 10 in. long when extended. There are three sliding sections, each section being a flat plate with semicircular sides which act as guides for the sections. In the centre of each side, and running almost the full length, are slots with rivets therein. These rivets only act as stops for limiting the travel of each section, preventing the cover pulling apart. They contribute nothing to the telescopic action of the cover, which is entirely self-supporting owing to its shape. The rivets are a loose fit in the slots and each has a thin

brass washer on its inner end, this washer being bent to conform with the internal contour of the section sides.

Figs. 1 and 2 show how the outer section of the cover has a lug bent up for securing to the lathe saddle. There are two small screws with nuts in the end of the cover's inner section. In action,

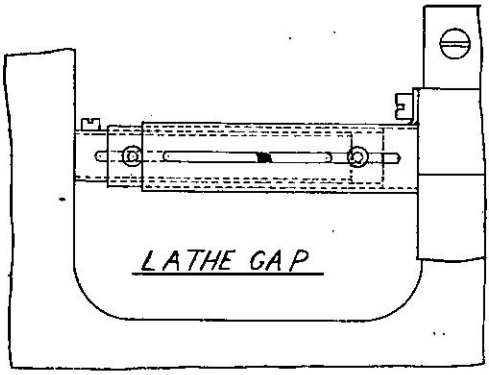


Fig. 2

the lower ends of these screws contact the edge of the lathe gap when the saddle is traversing along the bed towards the tailstock. The friction in the cover sections is thus overcome and the cover extends. A 10-in. extension permits most chuck work to be performed ; but should a long job be in the machine, it is necessary to lift the end of the cover, to permit the screws to slide along the top surface of the lathe-bed, and the saddle to traverse along, dragging with it a 10-in. cover which is quite an adequate swarf catcher.

On traversing the opposite way, towards the headstock, the cover remains extended until it contacts the front of the headstock casting, whereupon it starts to close.

I made my cover with a closed length equal to the lathe's gap width, since I object to the saddle hanging over the gap edge and I am able to work right up to the chuck jaws without closing the cover completely ; so there is a bit to spare. I'm sorry to say that large face-plate work necessitates the cover's complete removal from the lathe, but this is no great trouble, since face-plate work is in the minority.

Having decided on the closed length of the cover, it is necessary to find the lengths of the sections ; so deduct from the closed length half an inch for every section you intend to have in the cover after the first. For instance, if your cover is to have a closed length of 3 in. with 3 sections, then 2 in. will be the length of each section. Keep the number of sections at a minimum, because long sections work smoother than short ones. The width of the cover's flat portion on the smallest, or inside section is equal to the width of the lathe-bed's top surface. The minimum diameter for the curved sides of this section is about $\frac{1}{2}$ in., giving a $\frac{1}{4}$-in. radius.

Start by making a wooden former $\frac{1}{2}$ in. thick, about the same length as the section to be made, and equal the other way to the lathe-bed width, plus $\frac{1}{2}$ in. Plane or spokeshave a decent-looking semi-circular radius on the two edges denoting the cover width. Keep the edges parallel, but do not bother to produce a geometrically perfect form.

Cut out some reactangles of sheet steel, minimum 24-gauge (I used galvanised stuff), which should be reasonably smooth and flat. The rectangles should be equal to the section length one way and equal to the lathe-bed width the other way, plus about $2\frac{1}{2}$ in. Make one section $\frac{1}{2}$ in. longer than the section length to form the lug for securing to the lathe saddle ; this will be your outer section. Clip this piece to shape for forming the lug, and while it is in the flat condition, drill the holes in the lug for the fixing screws.

A word about cutting sheet-steel : I never use snips, not having a sufficiently robust pair. I usually lay the sheet on the floor, on top of an old piece of structural channel-iron, and run down the scribed line with a cold chisel and hammer. Get in line with the line you want to cut. Incline the chisel away from you so as to induce a shearing action ; hammering will cause the chisel to make short jumps towards you, and so shear and traverse automatically with each hammer-blow. You will not penetrate right through the sheet at every blow of the hammer, but the piece will break off easy enough.

Trim the rough chisel marks from the edges of pieces of steel by filing ; also, flatten the pieces by a little judicious hammering. Now take the

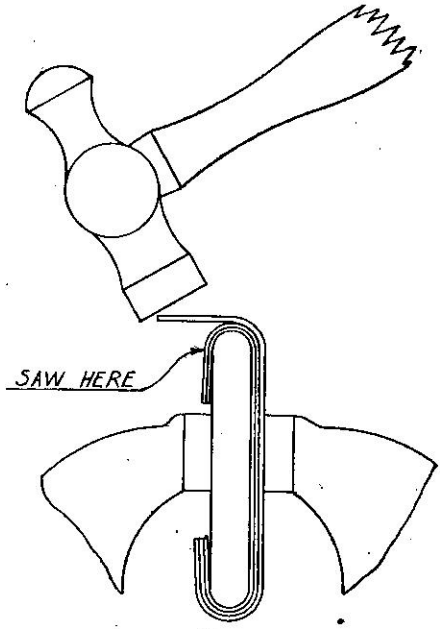


Fig. 3

wooden former and the first section and grip them between the vice jaws. Hammer the metal around the radiused edges of the former. Turn it over in the vice and serve the other end likewise. Take piece number two and hammer it over the first one and so on *ad lib.*

Fig. 3 shows the third section being hammered

in place. If the bent-over edges refuse to lie down neatly, squeeze them together in the vice; slight springing back is inevitable, but not a cause for grief.

Now grip the whole assembly, complete with former, on the rounded edges between the vice jaws and saw off the excess metal, as indicated in Fig. 3. This is an easier way of finishing the job than calculating the exact width of the pieces and trying to bend them accurately.

Burrs and rough edges will have now united all the sections together as one, and it is advisable to knock the whole assembly to pieces and remove the burrs. Use a file for this and watch your fingers on the sharp edges.

The grooves must now be milled for the stop-pins. For an end-mill I used a Slocombe centre-drill, a professional dodge often used for milling small keyways. Only the straight portion of the Slocombe is used, and this is given a little extra backing-off by hand on the tool grinder. There is no need to remove the conical point, just leave it as it is, because it cuts better that way.

Assemble the sections together on the wooden former and mark off the extremities of the slots which should come about $\frac{3}{8}$ in. from the section ends. Pack up the job on the lathe boring-table so that the curves of the $\frac{1}{4}$-in. radii and the lathe centre are somewhere in line, plus or minus $\frac{1}{16}$ in. will do. Grip the prepared Slocombe drill in the chuck and traverse the job along past the point of it until the job is in line, then clamp down tight. Running the lathe on top speed, take a succession of shallow cuts between the marks on the cover sides until you break through into the wooden former. Turn the job around in the lathe and mill the other slot.

Separate all the sections from the former and remove the burrs thrown up by milling. The sections should now slide smoothly together with a little stiffness. If they are sloppy, tighten them by re-assembling on the wooden former and apply the hammer judiciously to close the gaps, particularly those on the semicircular sides.

For the stop-pins, I used standard $\frac{5}{16}$-in. iron rivets with their shanks reduced in diameter sufficiently to enter the slots with about 1/64 in. clearance. Brass washers from old electrical junk were first bent and dropped on the rivet shanks inside the curve; then the rivets were bumped over, but only sufficient to hold the washer and allow the slides to work freely. Insert the two catch screws on the inner section and nut them in place. These should be of brass, to avoid scratching the lathe-bed when sliding thereon.

To mount the cover, place it in position on the lathe-bed and scratch the outline of the two securing holes on to the saddle casting. On some lathes, such as the 3½-in. Myford, the vertical lug for securing will be unsuitable, owing to the saddle casting's narrow section. It is suggested that the lug be horizontal in such cases, as there is sufficient space on the top of the saddle casting to permit the admission of fixing screws.

Remove the saddle casting from the lathe to drill and tap the fixing screw-holes, whatever their position.

While the lathe is dismantled, drill and tap a further pair of holes in the cross-slide casting's rear face, and fit a one-piece guard to this. Make it from sheet with radiused sides, as for one section of the main guard.

Oil every slide liberally before re-assembling, and apply some oil to the sliding sections of the bed covers.

Though such a cover will prevent 99.9 per cent. of swarf contacting the slides, it should be removed periodically and any fine particles of dust that may be adhering to the slide surfaces should be wiped off.

Small Steam Turbines—(*Continued from page 9*)

(*d*) The diameter of the rotor must be a compromise between the advantages of a large diameter, the need for regulating the weight, and the need for proper spacing of the blades. At the moment I suggest the trial of a 3-in. rotor, with 60 blades, blade width approximately $\frac{5}{16}$ in. or $\frac{3}{8}$ in. across the arc, blade arc about 120°, with nozzle angle approximately 22½°, more or less as found best according to the revolutions made under load. All tests should be made under load; the revolutions made when not under load count for nothing. Experimental rotors can be made quickly by using the twisted blade method; the rotor indicated would require three discs, 20 blades to each, the three discs riveted or bolted together when the blades are properly spaced (a method first suggested, I believe, by Mr. H. H. Harrison); but be careful to drill the holes through the three discs at once, marking them and assembling them similarly, the outer discs only one blade space distant from the originally drilling. This warning is based on experience.

(*e*) The gear ratio must suit the rotor and the load. I can only give guidance so far as to say that experience shows that the reduction has generally been less than I anticipated was necessary. The velocity ratio between the turbine and the thing driven is the determining factor, e.g. a propeller will require a smaller reduction than a crane designed to pick up heavy loads at low speed, or a locomotive with large driving wheels. With the latter, the possible advantage of chain drive for the final reduction and also for coupling, in certain cases, should not be overlooked.

(*f*) For marine propulsion, the rotor, the gear reduction and the propeller must suit each other. The size of propeller for the best over-all efficiency has been greater, and the gear reduction less, than I expected—surprisingly so.

This article has been rather long, and, I hope, not too tedious to the reader; but the lee-way to be made up in the development of the small turbine is so great, that it was impossible to cover the necessary field, giving the required explanations to make things clear, without going into the subject at some length. If its results are a move forward in the search for turbine efficiency, supported by an adequate number of readers, I shall feel well rewarded. At present, the apparent lack of development in the small steam turbine is a blot upon the good name of the model engineering fraternity. Who will rally to the task? "The greater the task, the greater the achievement!"

How to Make a Cheap
DRILLING MACHINE

By V. E. BENYON

FOR those beginners who do not possess a drilling-machine the following may be of interest.

The result of a first attempt at making such a machine, some time ago, was as shown in sketch, from which it will be seen that the main portion was made up from parts of a polished-head of the usual pattern which had ⅜-in. diameter spindle complete with Vee-pulley and a small drill-chuck. The table was made to rise and fall while the spindle just rotated in the one plane. This arrangement was fairly satisfactory and in use for a long time; but is was decided to convert it into the usual style of machine.

Consideration was first given to see how much of the original parts could be worked in, and it was decided to retain the base and pillar, the top support and the table support together with the

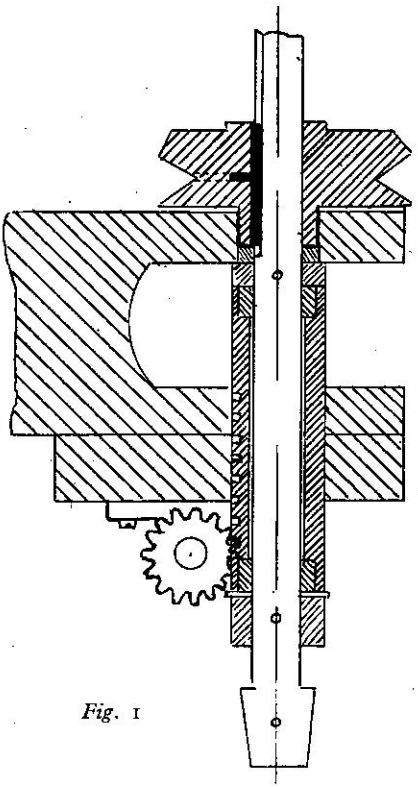
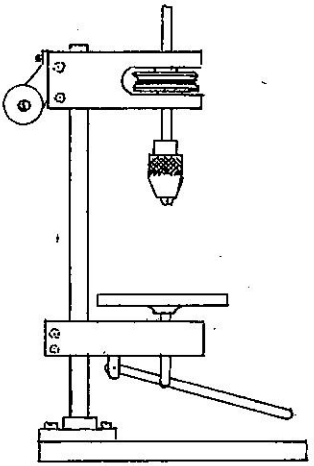


Fig. 1

three pulleys, although it was realised that drill travel would be limited due to lack of depth in the top support unless it was thickened up in some way. A drawing (Fig. 1) was then produced and appeared to meet requirements.

The sleeve was tackled first, by taking a piece of steam-pipe having an outside diameter of $\frac{3}{16}$ in. and turning it down to $\frac{3}{4}$ in. This was fitted with phosphor-bronze bushes, as shown in Fig. 1. A $\frac{3}{4}$-in. diameter hardened pinion was found and



The original machine

the slots, of a similar tooth-pitch, made in the sleeve with a warding file. The method adopted was to file the first slot near to the bottom and then to set a tool-maker's clamp the requisite distance along the sleeve to act as a file-guide for filing the next slot. When all slots were cut, the edges were slightly rounded, and the whole polished up in the lathe by mounting it on a ⅜-in. mandrel and run between centres.

The top main-piece was then taken in hand and a ½-in. steel plate filed to size and fastened to the under-side by four No. 4 B.A. screws, in order to give greater support to the sleeve when in its lower position and thereby increase drill travel. This piece of plate also had two dowel-pins fitted to ensure correct location should it be necessary to remove the screws during subsequent machining. The whole issue was then chucked in the four-jaw and bottom ⅜-in. hole bored out to a nice sliding fit over the sleeve, while the top ⅜-in. hole was bored out to ⅝ in. A bronze bush bored ⅜-in. was fitted into this latter hole in such a manner as to enable the pulley-boss to be recessed into the top support and so remove stress from the spindle, one side of the original pulley flange being turned off to allow for this arrangement. The spindle is a piece of ⅜-in. diameter silver-steel, on one end of which a tapered collar is driven tight and pinned, the taper being made

(*Continued on next page*)

A Remarkable Model Tank

(Cover Story)

A VERY complete model of a "Comet" tank was shown at a "War Activities Exhibition" opened to the public by The English Electric Company, on November 19th, at Queens House, Kingsway, London.

The original tank is of all-welded construction, and the "Comet" design was the first to use this method. It played a vital part in the final break-up of the German army. It is of the heavy cruiser type, and has an all-up weight of 32 tons. Powered by the Rolle-Royce V-12 Meteor engine, the speed cannot yet be revealed, but it can be stated to be "over 30 m.p.h." It carries a crew of five—driver, gunner, auxiliary gunner, loader and commander. The armament comprises a 77-mm. 17-lb. quick-firing anti-tank gun, which fires both armour-piercing and high-explosive shells. There is also a 7.92-mm. BESA machine-gun in the auxiliary gunner's compartment, and a 2-in. smoke-bomb-thrower enables the tank to make its own smoke screen. All these features—as far as their external parts are concerned—are very faithfully shown on the model.

As far as possible, the original materials are used in the one-sixth-size model; but, for the tracks, it was found expedient to use phosphor-bronze for the segments instead of the original steel: all these are machined from specially-made castings, and the workmanship of this detail is of a high order. The wheels on which the tracks rotate have their rubber tyres bonded to the steel, and the springing, which makes the passage of the tank over rough ground comparable with that experienced in a civilian lorry, has been copied with scrupulous care. The full equipment for track-tensioning has been reproduced.

The access doors to the engine compartment and to the crew's entrances in the turret and elsewhere, the inspection doors at various points, the towing gear, and the wireless aerials and other equipment are all reproduced with the utmost exactness. Even the driving mirror is sprung as in the prototype, and the picks, shovels and crow-bars carried on the outside have all been made in miniature and fitted in tiny, workable spring-and-screw clips. The turret revolves on ball bearings exactly as in the original, and the rough finish to the welded seams has been copied in a life-like manner.

The model was shown at the exhibition, mounted on a stand on which were installed two moving belts, one for each track, and, the tank being anchored, these belts drive the track round at about 2 r.p.m., thus showing the action of the track sprocket segments and springing.

The "Comet" was manufactured in large numbers at The English Electric Company's Stafford works, and the model, which weighs about 2 cwt., has been made by an associated company, D. Napier & Son Ltd., at their Luton experimental flight establishment.

The photograph is reproduced by courtesy of Messrs. D. Napier & Son Ltd.

How to Make a Cheap Drilling Machine

(Continued from previous page)

to fit a ½-in. Jacobs drill-chuck. The other end of spindle was then set up in the lathe tool-rest and a keyway cut for a length of 2½ in. by using an end-mill made from a piece of ⅛-in. diameter silver-steel in the usual manner. Another similar keyway was cut in the pulley, and a key (shown black in Fig. 1) spigoted into the existing grub-screw hole to prevent it coming out. Suitable collars were then made a nice sliding-fit on the spindle, to which they were afterwards pinned as shown, so that it was raised and lowered with the toothed sleeve, a fibre washer being fitted between the lower collar and the sleeve to take the thrust.

The operating arrangement (Fig. 2) is quite straightforward and was easily made up from a piece of ¼-in. diameter silver-steel to which the pinion was keyed. The bearings are pieces of scrap ⅜-in. plate drilled and filed to shape, while the end bosses were turned from ¾-in. mild-steel, one of them being drilled to take the operating handle. Adjustment of the belt pulleys to suit the new height of the spindle pulley was done by making suitable new brackets. This completed the parts for the top portion and, on assembly, the drill travel was found to be 1¼ in., which is considered ample for a small machine.

The original lever arrangement for raising and lowering the table was discarded and a set-screw fitted through the table support so that the table can be set at any predetermined height in the usual manner.

Apart from the experience gained in machining

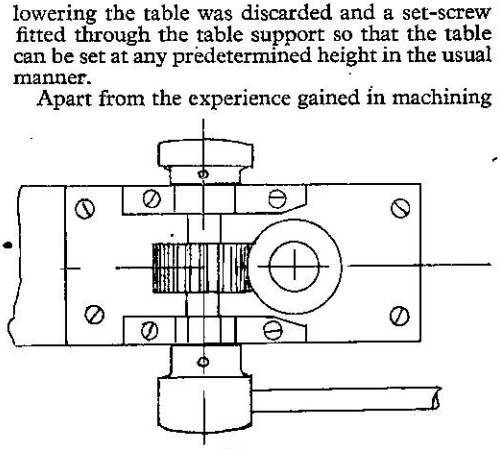


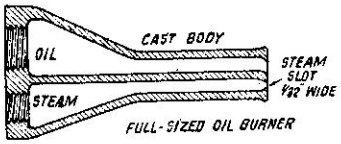
Fig. 2

and filing in the making of this machine, it has proved a very useful little outfit and definitely an improvement on the original layout, while the cost for the material used has been practically nil.

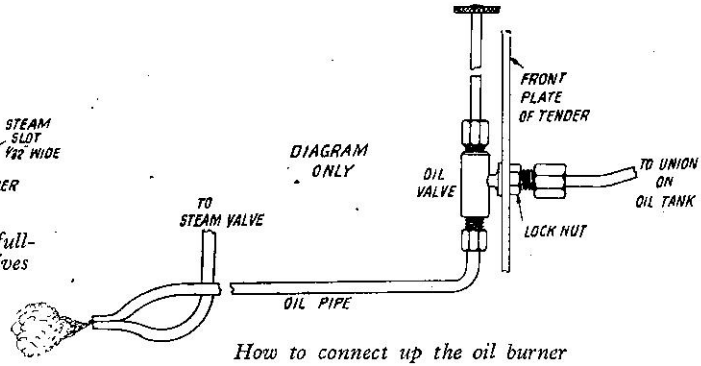
"PETROLEA"

reaches its final stages with the construction of the burner and other details, and "L.B.S.C." winds up by telling you how to drive the 3½-in. gauge edition of a 2-4-0 express locomotive of the old Great Eastern Railway

By "L.B.S.C."



Section of oil burner for full-sized American locomotives



How to connect up the oil burner

WHEN the popular daily newspapers get on to anything technical, especially when it concerns steam or electricity, you can bet your sweet life they make a complete hash of it; hundreds of enginemen not only chuckled, but laughed out loud, at the solemn assurance that 20 tons were saved by leaving out the running-boards and splashers on the Southern Railway "Q1" goods engines! I guess the said laughs were encored at a recent statement that "experiments in oil firing were being tried on the Great Western engines," the wording giving the impression that an oil-fired locomotive was a completely new innovation; whereas, as most followers of these notes know full well, oil firing has been in use for fifty years or more. Billy Stroudley tried it on one of the "D" class tanks No. 27, "Uckfield," but it was more complicated and cost more than coal at that time, so nothing came of the experiment. Oil-firing was revived again on the old "Brighton" at the turn of the century, the idea being to utilise the natural oil supply at Heathfield, Sussex; but when a dozen or so of the engines had been converted, the oil supply dried up, and so that was that! There is always a "something" that throws a spanner into the works of any promising innovation; when Jimmy Holden's engines burnt up all the residue from the oil-gas plant at Stratford, and started to utilise the waste tar and other combustibles from the local coal-gas plants, up went the price of what hitherto could hardly be given away; such, alas! is human nature. However, in the Southern States of America, where oil is plentiful and coal is scarce, it wasn't very long before they got busy and fitted their locomotives to burn crude oil. Whilst the small number of oil-burning engines in this country either had the Holden burner or its nearest relation, the American engineers produced a burner of absolute rock-bottom simplicity, which has persisted, with hardly any alteration, until the present day. It is also used in marine practice.

A typical American oil burner is shown in the sectional illustration. It consists of a brass casting, rectangular in section, with a horizontal partition dividing it into two compartments; the front section is quite flat, the upper compartment being only ⅛ in. in height, and the lower ½ in., the width being from 2½ in. to 4 in., according to the size of firebox for which the burner is intended. The back part of the burner is enlarged to accommodate the steam and oil pipes as shown, tapped holes for them being provided in the back of the casting. The front end of the burner has two slots in it; the upper one, through which the oil passes, is about ¼ in. wide, and the lower, or steam slot, is only 1/32 in. wide. The action is as simple as the burner; oil, which is heated by a steam coil in the tank when the weather is cold, dribbles out through the top slot and falls into the jet of steam issuing from the bottom slot, which blows it into spray and scatters it over the firebox in an inflammable mist. The lower part of the firebox is lined with firebricks, and a "flash wall," as it is called, is built of firebricks opposite the burner. Air is provided by a series of holes in a hopper-shaped ashpan, which has a cleaning door at the bottom. The burner is placed at the front of the firebox and "blows backwards," as the kiddies would say.

A Simple Edition for "Petrolea"

I hope the spirit of good old Jimmy will forgive me for introducing an idea from over the pond into his beautiful piece of mechanism; but as I've often remarked, you can't "scale" Nature, and a small replica of the pure Holden oil burner wouldn't operate like the big one did. The nozzles and passageways would be too small. I have therefore shown what is about the simplest form of spray burner it is possible to conceive. One of the old-time locomotive builders who used to contribute to this journal, Mr. Chas. Palmer, of New York, described a burner which resembled a weeny injector, having an oil hole a little over

1/64 in. and a steam hole only 1/100 in.; a screwed nozzle covering both outlets had to be carefully adjusted so that the combined steam and oil issued in a fine spray. This was successful, but would burn only paraffin or petrol and needed perfectly dry steam; a drop of water passing through put the fire out. The gadget shown will burn anything that will run out of the oil slot, and, although it prefers dry steam, an occasional drop of water will not affect it in the slightest. It can also be adjusted to make the box akin to what we hope is Adolf's present address, or just enough to keep the pot boiling whilst the driver has a cup of the engineman's best friend.

Nozzles

The nozzles are simply two lengths of 5/32-in. copper tube, about 22-gauge, flattened at the end, and brazed together as shown in the illustration. The slots require a little connivering to get them the right width. The best way to do the job is to hammer or squeeze the tube end perfectly flat, entirely closing the hole; then file away the end of the flattened part until, in the case of the oil slot, you can just see a black line.

For thin oil, such as paraffin, only a very narrow slot will be required; it should be about wide enough to admit a bit of paper about the thickness of the pages of this journal. For oil of greater viscosity, such as the waste oil from the crankcase of an automobile engine, a wider slot will be needed. The exact width is best found by experiment. As the burner is only held in place by the two pipe unions, it is merely the work of minutes only to remove it, adjust and replace.

The steam slot should be very nearly invisible. When you recollect that on a full-sized American locomotive with a boiler about 8 ft. in diameter and a huge barn of a firebox to match it, *the steam slot in the oil burner is only one-thirty-second of an inch wide*, you can quite appreciate that it doesn't need much of a steam slot to do the needful in "Petrolea's" little firebox. The way I made a suitable slot was as follows. The tube was softened, flattened and filed at the end, and there was merely a thin black line showing; in fact, it was so thin that it looked like a faint scratch across the flat end of the tube. A tyre pump was then connected to the end of the pipe and the nozzle end placed in a pail of water. When the handle of the pump was pushed hard enough to register about 30 lb. on the air gauge, a thin stream of bubbles came out, the full length of the slot. The force wasn't great enough to disturb the water; the bubbles just rose to the surface diagonally. If they had blown straight out, the slot would have been too big. There is not even a flash wall to blow against on "Petrolea"; merely enough steam has to pass to spray the oil over the small coal fire. Naturally, a certain amount of regulation can be obtained by the steam valve over the backhead; but best results are given by blowing steam at a good pressure through a very minute slot, as opposed to low steam pressure through a wider one.

Pipe Lengths

Don't forget that the pipe used for steam nozzle should be long enough to reach up the backhead to the steam valve; the oil pipe should be long enough to reach back to the front plate of the tender. Both should be furnished with union nuts and cones. File one side of the flattened end of each pipe until quite true, then tie the two together with thin iron wire, apply a little flux, and braze them with a bit of brass wire or Sifbronze them. The small detail sketch shows a section of the tube below the firehole, with the burner in place. The two slots should be about $\frac{1}{8}$ in. from the firebox end of the tube.

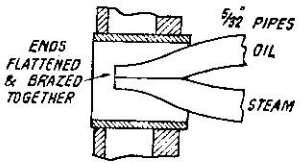
How to Erect and Connect Up

The oil supply is controlled by a screw-down valve attached to the front plate of the tender. This valve can be made from $\frac{5}{16}$-in. or $\frac{3}{8}$-in. round or hexagon brass rod, and its working parts are exactly the same as the blower-valve, and other screw-downs that I have described in full detail, so I don't have to go over all that again! The only differences on the outside are that the stem of the side connection is made $\frac{1}{2}$ in. long, countersunk deeply at the end and turned with a shoulder at the end of the thread. The bottom end of the valve is also screwed and countersunk. Drill a $\frac{1}{4}$-in. hole in the tender front close to the bottom of the coal plate, near the brake-handle on the fireman's side; poke the stem of the valve through it and secure the valve vertically with a locknut on the thread. The union-screw is then connected to the ditto on the oil tank—or on the connecting-pipe if the twin drum tanks are used—by a piece of 5/32-in. pipe with a union-nut and cone on each end. The oil-pipe from the burner is taken across the footplate, bent up to meet the oil-valve and secured to it by the usual nut and cone. The length of the pipe will allow it to flex when the engine takes a curve, and engine and tender run out of line. Any time it is necessary to uncouple the engine and tender, merely unscrew the union-nut, taking care, of course, to shut off the oil-valve. The stem of the oil-valve should project just above the top of the plate, so that it is accessible when you are riding on a flat car behind the tender. The steam pipe from the burner is merely taken up the backhead (see previously-published drawing of the backhead fittings) and connected to the union-screw on the steam-valve; the whole bag of tricks is then complete.

Final Details

Little more remains to finish. Followers of Inspector Meticulous could, if they so desire, turn the cab and tender pillars from $\frac{1}{4}$-in. round steel, and make them taper, with a flange at the bottom; but this is a refinement your humble servant wouldn't worry about. I just use straight wires, with a washer silver-soldered on for a flange. Lamp irons, as I said before, usually get knocked off pretty quickly; but if you want to decorate the engine with real head and tail lamps, and destination boards (loud hear-hears from Mr. Hambleton!), make your lamp brackets with a screwed shank, screwing into a tapped hole in the appropriate place in the running-board or wherever-is-it. When the engine is on a "business-only-meant" expedition, unscrew them and leave them in some safe place. Alternatively, electric lamps could be used, plugged

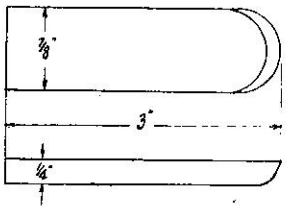
into weeny pin sockets flush with running-boards, a battery being carried under the tender. Other details, such as dummy brake pipes, can be added to taste; the pipes could be made from 3/32-in. copper wire (pipes for air-brakes are much slimmer than those for vacuum-brakes) and cycle-valve tube makes dinky hoses. I can hear friend Hambleton saying once more, "O.K., but don't forget the cocks!" Echo responds—"and the universal hose couplings!"



Simple oil burner for "Petrolea"

Painting

Regarding painting, big sister looked absolutely magnificent in her royal blue costume, lined out in black and red. The inside of the cab was a kind of buff, and the inside of the frames grey, the outside being black. The wheels were blue with black tyres, and the flutes of the coupling-rods were red. Smokebox, chimney, running-boards, tender-top and cab roof, all black; buffer-beams red. I believe the guard-irons were also red, but memory has failed on that point; ours were, on the Brighton. Any good heat-resisting enamel, such as used for baths and domestic radiators, would be suitable; also any good make of hard gloss paint. Mr. C. Bright, who did our bomb-damage repairs, uses a hard-gloss paint on his locomotives and prepares the surface with a rubbed-down grey undercoat; but I have never undercoated any that I have painted. My usual method is to give the engine a good wash down with petrol to remove all grease and oil from the surfaces to be painted (this is ALWAYS done outdoors—take heed, ye novices!) and thoroughly dried. Everything except the boiler is then given a thin coat of the desired colour and dried in a warm place over the boiler in my workshop; newspaper or brown paper "tunnels" are stood over the job to minimise the effect of dust settling. As to the boiler of the engine, it is filled very nearly full of water, and after being painted a small bunsen gas flame is put in the firebox and the water brought almost to the boiling point. About twelve hours at this temperature, which need not be continuous, "sets" the paint or enamel nice and hard, and renders it proof against oil splashes, dirty water, blistering and all the other ills that painted surfaces are heir to. After the engine has been run, always wipe it down with an oily rag or a bit of oily waste, and the boiler will have a permanent gloss on it.



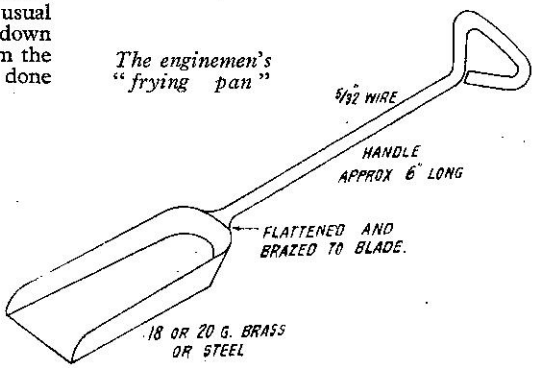
Former for fireman's shovel

Lining

Here are two little lining tricks that I don't remember giving before, though I may have done so a long while ago. You can always make a thick clean line by gumming strips of paper around the boiler or along the tender, leaving a blank space the width of the required line between the paper strips; then paint over it. When dry, remove the paper by wetting it, and there is your line! For a thin line, run the paint-brush along a piece of sewing-cotton; carefully plant the cotton where you want your line, and when you remove it again there will be a clean line where the cotton rested. Letters and figures are easy enough to put in with a fine brush or a drawing pen; try on a bit of metal, you will soon get the knack.

How to Drive "Petrolea"

Novices and beginners must always bear in mind that there is no natural draught in a little locomotive, and to start a fire, an artificial draught must be applied. Several means of producing a draught have been described in these notes, the latest being Mr. Adams's fan. The simplest one is to use an extension chimney, which is merely a piece of tube stuck in the locomotive's chimney and containing a blower jet which is supplied with compressed air from a tyre-pump. A tin can with soldered-up seams, or a football bladder, must be inserted somewhere between the pump and the chimney to equalise the flow of air to the jet; the latter is a bit of $\frac{1}{8}$-in. tube contracted at one end into a 1/32-in. nozzle ("'it it wiv an 'ammer," as Bert Smiff would remark) and put it through a hole in the side of the extension chimney so that it blows straight up the latter by virtue of a right-angle bend. Oil all the moving parts; fill lubricator, tender and oil tank; see that there is a supply of coal on board, broken up to pea size, with the dust sifted out. Welsh steam coal, anthracite, or a mixture of both, will be suitable fuel. There should be about half-a-glass of water showing in the boiler. A suitable fireman's shovel can be made by cutting out an iron



former to the shape and size shown, knocking up a brass or steel shovel blade over it, and brazing on a handle made from 5/32-in. iron wire. A pricker can be made by bending one end of a bit of the same-sized wire into a ring and bending ½ in. of the other end at right-angles.

Put a few shovels of paraffin-soaked charcoal into the firebox, get your blower going, then throw in a lighted match. As soon as the oily charcoal is well alight, fire up with dry charcoal to the level of the oil burner tube ; shut the door and keep blowing. Steam should show on the gauge in about three minutes ; meantime, add more charcoal if required. When steam appears on the gauge, open the engine's own blower and take the auxiliary away. You can then fire up with some coal, but don't go above the oil burner tube. When she reaches about 60 lb., open the cylinder drain, put the lever in fore gear and open the regulator a little. She will blow a lot of water from the cock as she moves off—don't ride on the car yet—but when dry steam issues from the cock, you can shut it, then she is ready to take you for a trip. Take your seat on the car, open up steadily, and your patient work in building the engine will receive its reward.

"Keep on Keeping On"

On an up-and-down track there is not much chance of notching up, as the average length of run is so short ; but on a continuous run you can bring the lever back almost to mid-gear, shut off the blower and "keep on keeping on" all the time there is water in the tender. Every good engineman keeps a wary eye on the water gauge ; as soon as the level drops to about one-third, open the injector water-valve and then the steam-valve. If there is any dribble at the overflow when the injector is working, close the water-valve a little till it ceases. Shut off the injector when the water reaches within ⅛ in. of the top of the glass.

To use the oil burner, see that there is a fairly good bed of incandescent coal in the box. Open the blower-valve ; it is always best to keep this open a little all the time the oil spray is in action. Then open the oil-valve and turn on the steam steadily. There will be a little splutter whilst condensate water blows out of the pipe ; then there will be a roar and the firebox will be full of white flame if paraffin or thin oil is being used. If thick oil or waste is being burnt, it will cause a yellow inferno and probably some smoke (gas-mask called for !) and you'll smell the bloaters cooking long before reaching Yarmouth ! It will require a little practice to regulate the steam and oil at first ; but when you get used to it you'll be able to set both steam and oil-valves instantly, to keep steam at blowing-off point with any load. Add a little coal at intervals to maintain a fire bed for the oil to spray on. When you are running on coal only, plug the air space around the burner with a wad of asbestos flock to prevent air going in. Final warning : never let the engine go short of lubricating oil ; keep the water always above one-third of a glass ; keep the engine clean, drive her carefully and she will give you many years of real pleasure.

Transfers for Models

By R. BROWN

ON completion of a model yacht hull, I came to the question of adding the finishing touches which make all the difference to the appearance of a job, and the problem which confronted me was the addition of the name on the bows.

Never having tackled a job of this type before, I was very apprehensive of being able to hand-paint the name on to the bows ; so my thoughts immediately turned to obtaining or making transfers. Several experiments were tried to make them, and a method was found which gave very satisfactory results.

The size and type of the name to be used was agreed upon, this being obtained from printed type in periodicals or magazines. A roll of the gummed transparent music-repairing paper was bought, and two pieces 2 in. longer than actually required were cut off from the roll, one piece being required for each transfer, as I was making two for the name on each side of the bows.

On the ungummed side of the paper, the letters were traced between two lines previously drawn on the paper as guide lines. The thickness of the letters is all that is required, and there is no need to fill them in. This side is then coated with Seccotine and a piece of stiff cardboard, approximately the same size as the piece of transparent paper, is glued on. This is to ensure that when attaching the transfer to the article, the paper does not crinkle.

The pencilled letters can now be seen through the gummed paper reading backwards. These can now be filled in, on the gummed side, with a pen and the required coloured paint thinned slightly for the job. Water-colours should not be used because, when removing the paper from the article with water, the paint will run. This should be allowed to dry, and should a background be required it can be painted over the letters.

The transfer is now ready for use and should be applied in the same way as any commercial transfer, either gold-size or transfer-varnish being used for attaching. When the gold-size or transfer varnish is nearly dry, the backing paper should be thoroughly wet with warm water and carefully peeled off. A final application of varnish will ensure a permanent and neat transfer.

Two points are worth observing. The first is is, if difficulty is experienced in getting the paint to run on the gummed paper, a dusting with French chalk will remove this tendency. Secondly, a dog-eared corner of the transfer should be left to facilitate the removal of the backing-paper.

*IGNITION EQUIPMENT

By EDGAR T. WESTBURY

A comprehensive review of the working principles, design and construction of electrical ignition apparatus employed on all types of internal combustion engines

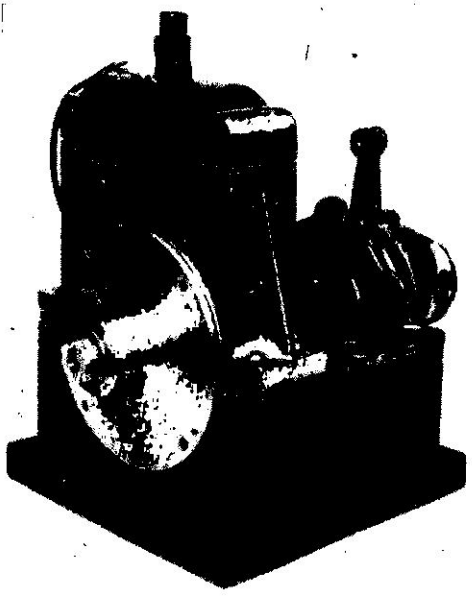
Part II—Design and Construction (*Continued*)

EITHER of the two magnet assemblies just described may be used in conjunction with the stator design of "Atomax I," in place of the solid cruciform magnet originally employed. But in the design of "Atomax II," some important modifications have been made in the construction of the stator, though the working principles, also the magnetic circuit and the electrical design, remain exactly the same.

The primary motive in the design of this magneto is to enable it to be adapted to practically any existing engine of from 15 to 30 cc. with the minimum trouble, and with little or no structural alteration of the engine or its installation. It may therefore be regarded, to all intents and purposes, as a "conversion set" for changing over an engine from coil to magneto ignition, comparable to the units described in the first part of this series, which have been extensively applied in full-size practice; and, while no attempt whatever has been made to cut down the weight of its essential parts, the conversion will usually show some advantage in this respect over the average coil ignition system employed on these engines.

The stator unit of "Atomax II" consists of a cast-aluminium bridge, adapted to be bolted down on the engine bearers and having the side radius of the arch machined to fit over the rotor unit—which takes the place of the normal flywheel—with the minimum working clearance. Laminated stator pole-pieces are cast into the bridge, in their correct position, and their pole faces machined *in situ* to the same radius as that of the casting. One great advantage of this method of construction is that it provides the utmost rigidity of the stator and enables the pole faces to be machined with no risk of the spring and chatter experienced with the earlier form of design (see Fig. 67).

*Continued from page 585, "M.E.," Vol. 93, December 20th, 1945.



A demonstration model of the "Atomax II" magneto

In the execution of the method, however, some technical difficulties were encountered, as it was found impracticable to locate the laminations sufficiently accurately by any method other than die casting. This part of the work, however, has been successfully carried out by Mr. L. Powell, of Cheadle, who will be known to readers as the producer of the excellent die castings for the "Atom V" engine described some time ago. Mr. Powell also co-operated with me in developing the magnet assemblies for the magneto.

From the photographs of the component parts of the "Atomax II," and the assembly which I have used for demonstration purposes, it will be realised how easy it is to apply this magneto to an existing engine. The rotor hub or adaptor plate is bored to fit the engine shaft in place of the flywheel, and the stator bridge is then bolted over it with due precautions to ensure concentric clearance, so that it is just clear of rubbing contact. If the engine bearers do not happen to be exactly on the level of the shaft centre line, it is necessary to fit packing under the feet of the stator bridge. The simplest way to locate the stator is to wrap a piece of thick brown paper around the rotor and to put the stator over it, where it will adhere firmly by magnetic attraction, and measure the clearance under the feet with feelers, slip gauges or callipers. If the distance from the support is fairly considerable, it may be desirable to use wood packing blocks, in which case some allowance should be made for their compression when bolted down. As air-gap clearance is not critical with this type of magneto, I have found no difficulty in fitting with any engine on which it so far has been tried out.

This magneto is quite suitable for such engines as the "Kiwi," "Kittiwake," "Apex Minor" and "Atom V"—to mention only those which have been made familiar to readers through my own articles. It is

quite possible to adapt it to the " 1831 " engine, by modifying the existing flywheel to project further from the engine and bolting the rotor behind it. The transmission shaft will in this case have to be shortened to suit. If anything, the extra engine weight will be an advantage, particularly as it is partly flywheel weight, in which the original engine design is, perhaps, a little deficient. The diameter of the rotor used for " Atomax II " is such as to allow of fitting between the locomotive frames quite easily

In engines originally fitted with very heavy flywheels, the rotor weight of the magneto may not be considered sufficient to form an adequate substitute, but it may easily be augmented by an extra disc of metal mounted on the hub, outside the stator position. If this is in close proximity to the magnet, it must obviously be made of non-ferrous material to avoid " shorting " the magnet poles. Another practical way of supplementing flywheel weight in engines which have a two-bearing crankshaft, is to fit an extra flywheel at the end of the shaft remote from the magneto ;

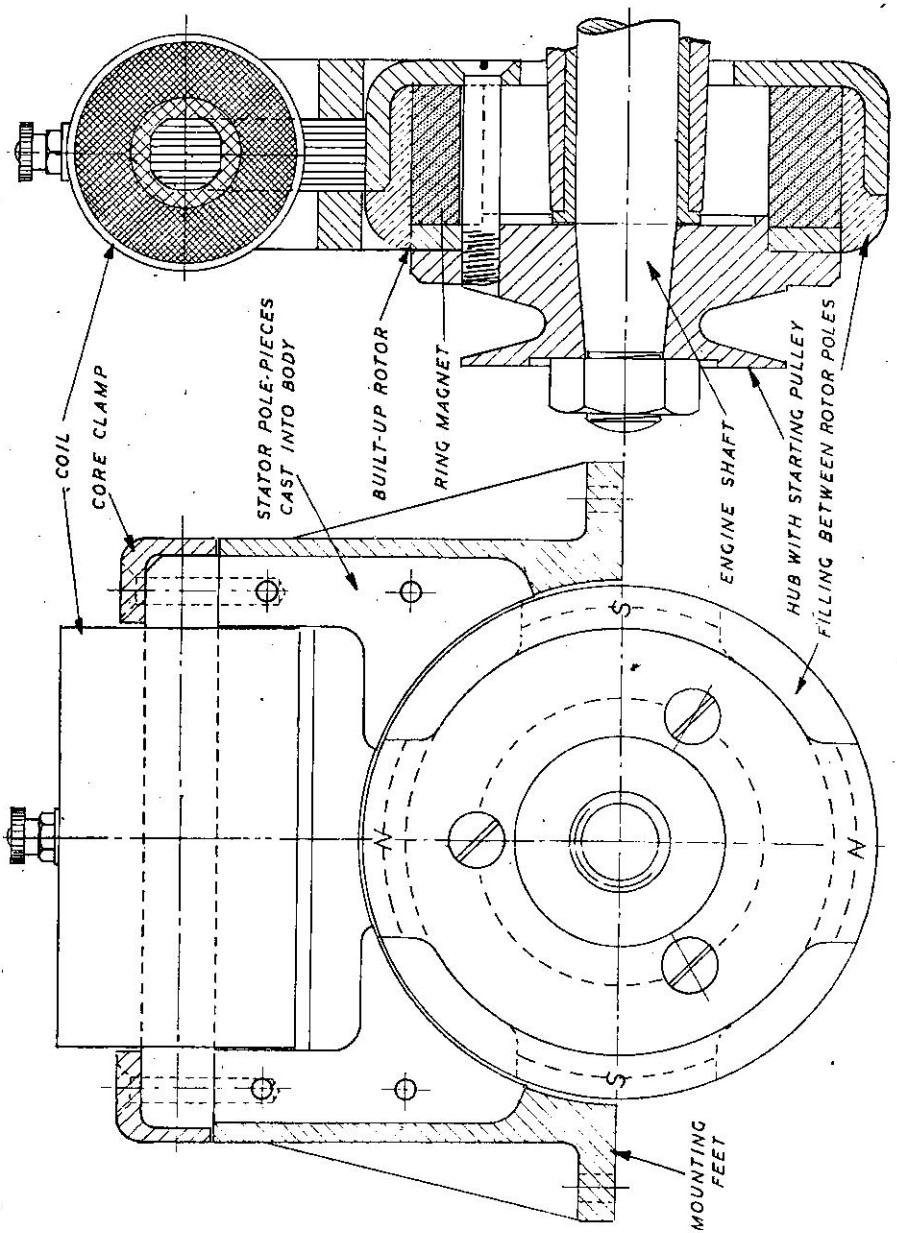


Fig. 67. " Atomax II " (conversion type) magneto, with " magnet assembly A " fitted

a method strongly advocated for marine or stationary engines, where limitations of weight and space will permit.

In the case of a twin engine with even firing intervals (as, for instance, that designed for "1831") or most other forms of multi-cylinder engines, the original contact breaker and distributor employed with coil ignition can be utilised to serve equally well for the magneto. All that is necessary is to carry the low-tension or primary lead of the magneto coil to the low-tension contact-breaker terminal, and the high-tension lead to the centre terminal of the distributor. For single-cylinder engines, it is assumed that, in the normal course, the original contact-breaker will be retained and used; the condenser is, of course, necessary in all cases, and it will usually be found that the capacity of condenser used for coil ignition will serve at least tolerably well for the magneto, though experiments with various capacities are always worth while.

It should be observed that, as the four-pole magneto is capable of producing four sparks per revolution of the rotor, either form of "Atomax" can be used on the engine shaft to provide ignition for a four-cylinder two-stroke or an eight-cylinder four-stroke. Vee twin engines, however, call for special treatment, and engines having three or six cylinders can only be dealt with by using a six-pole magnet, with its appropriate stator.

Snags and Setbacks

Although the "Atomax" design is as simple and straightforward as one could wish, it should not be supposed that its development was all plain sailing. It has been my experience that every step in experimental research is capable of producing its quota of "blood and tears, toil and sweat," and details which afterwards seem so absurdly simple and obvious, are often "anything but" when one is working them out for the first time. Snags develop in the most unexpected places, and, while one is concentrating on the problem of scaling the mountain ahead, one's feet are very liable to trip over a molehill. And so it was with the development of the "Atomax II" magneto.

The first experimental "hook-up" of the "Atomax I" magneto worked extremely well, as so often happens when one makes a rough working model to test out an idea. It was fitted to the 15-cc. two-stroke engine shown in the photograph in the December 6th issue and, although the engine itself, being of *very* experimental type, gave plenty of spots of bother, it was possible to eliminate suspicion of ignition trouble almost entirely. This magneto still works satisfactorily, though it has been subjected to every sort of abuse one can imagine; the only point which seemed open to criticism was the lack of rigidity of the stator structure, which, apart from difficulty in machining, appeared a potential source of mechanical trouble, should the engine ever take any hard knocks under working conditions.

When an attempt was made to improve on this feature by casting laminations into a solid stator unit, however, a very peculiar, and for a time inexplicable, trouble arose. This was a bolt out of the blue, as trouble had certainly not been expected in this direction; it is well known that the casting-in of laminations is common practice on full-sized magnetos, and that it does not in any way impair their electrical efficiency.

When the cast stator of the "Atomax II" was first tried out, however, no spark worth considering could be obtained from the magneto at all. Tests of each separate component showed that all were, apparently, in perfect working order. The primary circuit was found to be capable of generating alternating current in a more or less normal manner, and voltage was also produced in the secondary, though never reaching the potential necessary to produce a spark.

Many experiments were made with the angular width and overlap of the rotor and stator pole faces, without making any very material effect on the performance. It was, unfortunately, impossible to interchange rotors and stators with the "Atomag I," owing to a slight difference in the sizes. Tests of both the primary and secondary wave-forms by means of the oscilloscope revealed that in both cases the characteristic peaked wave was conspicuous by its absence; instead, both

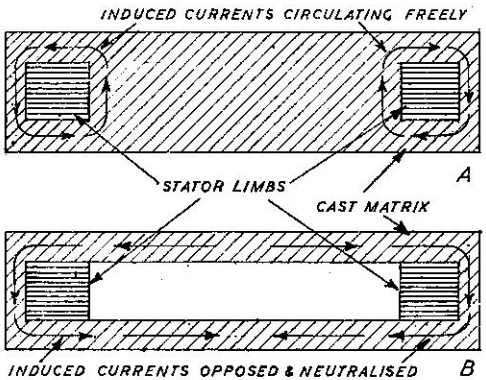


Fig. 68. Diagram showing the effects of embedding stator limbs in metal casting

circuits produced a blunt wave-form, flatter on the top than the orthodox a.c. sinusoidal wave. This obviously accounted for the failure to produce a spark—but why, oh why?

Things were still as obscure as ever, and, of course, the real underlying cause of the trouble, as usual, long remained unexpected. Both Mr. Luttmer and myself wrestled with this problem for three months, during which we spent many sleepless nights and consumed prodigious quantities of aspirin.

At this point, perhaps, it might be a good idea to follow the example of the clever detective novels and seal up the last chapter to see how good readers are at deduction—or mere guessing! I wonder how many of my readers have hit upon a clue as to why the casting-in of the laminations could have destroyed the sparking efficiency of the magneto?

The reason dawned on us quite suddenly, and —again in keeping with tradition—while we were looking for something quite different. I believe I have mentioned that, while developing the oscilloscope, we encountered some little difficulty

in holding the image steady on the screen of the cathode-ray tube for the purpose of photographing it. The biggest trouble was due to the "hunting" or surging of ordinary universal or induction motors, due to the armature running into and out of phase with the periodicity of the mains supply. In attempting to correct this, we made some experiments with "shaded-pole" motors; that is to say, motors in which a magnetic lag is produced in a part of each field pole by "shading" it by an encircling metal ring or a short-circuiting winding. The details of this quest do not concern us at present, but the fact is that in the course of these experiments, it suddenly occurred to us that the stator poles of the "Atomag II" magneto were well and truly "shaded" by being embedded in solid metal!

By way of an explanation of the curious phenomenon known as magnetic shading, it may be said that any conductor around a magnet produces currents when any change of flux takes place, just as occurs in an armature or exciting coil of any kind.

A simple illustration of the effect of "shading" an induction coil may be provided by the following experiment: Take any spark coil which has the core projecting beyond the windings at one or both ends, and put it on test, so as to produce sparks across a normal spark gap. While it is sparking normally, take an ordinary washer, preferably of brass or copper to provide good conductivity, and slip it over the projecting end of the core. Immediately, the spark will be almost or completely damped out, depending on the "tightness" of the magnetic coupling produced by the washer or shade ring.

Incidentally, this provides an important object lesson on the need for avoiding any kind of a closed circuit, through shorted turns or otherwise, in the magnetic field of a coil—including the use of a brass band around the outside of the casing, to clamp the coil in position.

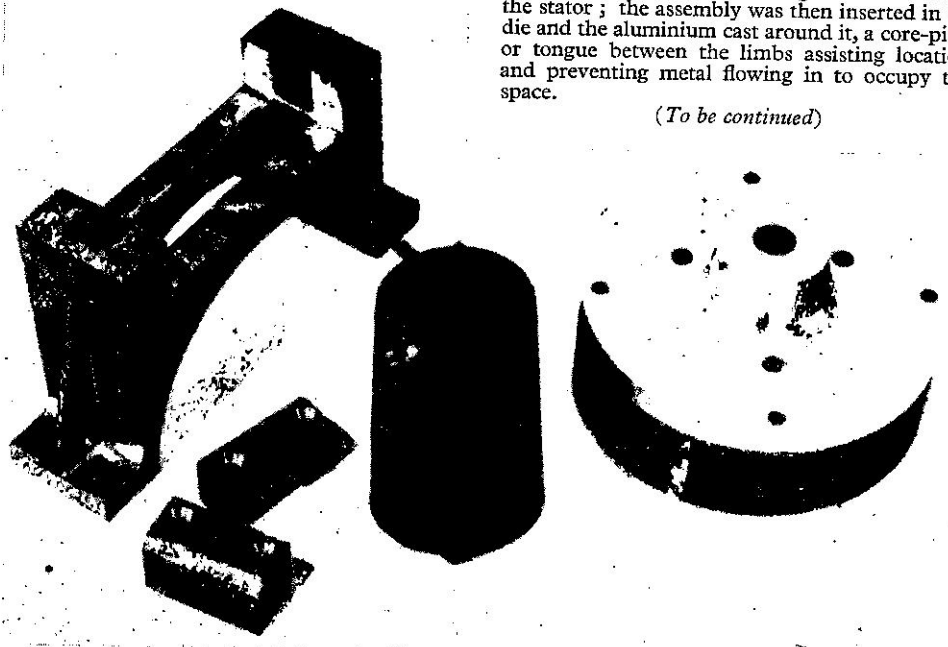
Finding the Remedy

The conditions existing in the stator of the "Atomag II" are illustrated by the sectional plan view in Fig. 68A, in which it will be seen that each limb of the stator is completely encircled by metal, which produces the effect of a tightly-coupled low-resistance shade ring. At each change of flux in the stator, eddy currents are produced around each limb, as indicated by the arrows, which represent the direction of flow in the limbs at one particular stage; this would, of course, be reversed at each half-cycle of the exciting flux.

To cure the trouble, it was necessary to remove the metal between the limbs of the stator, as shown in Fig. 68B. In this way the tendency for currents to be produced around the limbs still remained, but instead of being short-circuited, the rings were incomplete, and the two half-loops around the limbs were opposed in polarity, so that they cancelled each other out. This enabled the magneto to function normally and efficiently, and no further trouble in this respect has been encountered.

From the structural point of view, however, things were not so satisfactory, as the stator laminations were not locked in place on the inside, and were liable to shift with the contraction of the casting on cooling. This was remedied by Mr. Powell, by riveting the two sets of laminations between brass plates, extending the full width of the stator; the assembly was then inserted in the die and the aluminium cast around it, a core-piece or tongue between the limbs assisting location, and preventing metal flowing in to occupy this space.

(*To be continued*)



Essential components of the "Atomax II" magneto, showing "magnet assembly B" on right

Letters

Where are the Northerners ?

DEAR SIR,—*Re* Mr. John Houstoun's letter in THE MODEL ENGINEER of November 15th last, while I am not capable of defining the geographical boundaries of North and South, I suggest that you cannot draw a dead line. But as to the reticence of the Tynesiders, let my very recent experience speak for itself. A note to one of the joint Hon. Secs. of the Tyneside S.M. & E.E. brought a reply asking me to call at his house so that he might have what he called a " private session." It was duly held and several members turned up and conversation ranged from models to THE MODEL ENGINEER and its contributors. Tribute should also be paid to the lady of the house, who provided tea and cookies as an added enjoyment. Right here, may I assure Mr. Crebbin (he was " Uncle Jim " to them) and Mr. Westbury, that if ever they visit Newcastle they will be heartily welcomed.

Next, I was invited to visit the Society's workshop a few minutes' walk from Newcastle Central Station, and in company with Mr. J. E. D. Scott, of Tyne Dock, the workshop superintendent, I did so. Here was a large oval railway track being relaid with a view to scenic effects, at one end of the shop ; at the other some half-a-dozen drilling machines were in various stages of construction. These machines were typical of the North, good solid workmanlike constructions, and though only designed for $\frac{5}{16}$ in. capacity, seemed to be of such robust construction that they would easily take a $\frac{1}{2}$-in. drill. My opinion was echoed by one member who was making one with a few added refinements, such as chromium-plated handles and bakelite knobs, to act as a small vertical milling-machine with the addition of a universal slide-rest table. The main pillar is $2\frac{1}{4}$ in. diameter. A long bench had groups of tools arranged on it for such diverse jobs as boat hull carving, metal work and bookbinding, and a note at the end asked members to keep them as arranged and was signed (in chalk) " The blokes wot did it."

Then Mr. L. Brough came along and ran Mr Scott and myself out to his private workshop. Small gear-cutters were produced, made from articles in THE MODEL ENGINEER, and a home-made projector for inspection purposes. One of Mr. Westbury's road roller engines was set going, as was also another of his design, but of more noisy vintage. A filing machine (also MODEL ENGINEER) bobbed sedately up and down, and Mr. Brough was loud in praise of it as a hacksaw machine. All machines were separate motor-driven. I was shown a photograph of a model boat on a pond and told it was steered by word spoken into a " mike " on the bank, and I was shown some of the apparatus that did the trick.

But the star turn to my mind was the ingenious and workmanlike way Mr. Brough had fitted automatic feed to the cross-slide of his lathe. In lathes fitted with the ever-useful boring-table type of cross-slide the actuating screw generally moves in and out with the slide, thus rendering it rather difficult to rig a self-act, except our hoary old friend the chain-and-ratchet. But Mr. Brough had got over all difficulties, merely as far as I could see, by drilling a few holes in the lathe to hold the extra parts and in positions where they in no way impaired the efficiency of the machine. In view of the large number of readers having lathes fitted with this type of cross-slide (myself included), I wish Mr. Brough would tell us how he did it. I left his shop with regret.

In company with Mr. Scott, I then visited two remarkable collections of early ship models. One of these collections is in the Newcastle Technical Museum, where the curator was most pains-taking in his explanation of the exhibits. It is the only museum in the country, as far as I know, to have a complete workshop on view fitted out for the once-popular pastime of ornamental turning and the lighter mechanical arts.

Time was short, so I had to refuse some invitations by the club members ; but I did manage a trip down a coal-mine with a party of them, and very interesting it was. I did not find any of the party very reticent, but I agree that a little more publicity on their part would be for the good of all. As to the honoured names at the end of Mr. Houstoun's letter, they speak for themselves.

Yours faithfully,

Luton. ERNEST W. FRASER.

Conjugated Valve Gears

DEAR SIR—With reference to the article on this subject by K. N. Harris in the October 4th issue of THE MODEL ENGINEER, he states that—

" On the Southern, locomotives with the Holcroft conjugated gear, and locomotives with three separate sets of gear, are running."

I would hasten to correct this statement and also assist him slightly in his statement.

Only two engines were ever fitted with the Holcroft gear :—

(i) No. 1822, N1 Class, 2-6-0 tender engine. Built in 1923.

(ii) No. 1890, K1 River Class tank engine. Built in 1925 and subsequently re-built as U1 2-6-0 tender engine.

Both these engines had the conjugated valve-gear removed about 1930 and put back into service with the normal three sets of valve-gear, which standardised their valve-gear with all the other U1 and N1 engines.

I believe a lot of trouble was experienced with the long valve-rods that ran forward outside the cylinders ; it appears they could not be made rigid enough without being excessively heavy. I have no doubt that considerable wear did take place in all the pin points and die blocks of the two outside sets of valve motion, as Mr. Harris points out.

Incidentally, there is one Lord Nelson class engine that has cranks set at 90°, No. 865, but she still has four sets of valve-gear.

In conclusion, may I take this opportunity in wishing THE MODEL ENGINEER every success and to thank you for the very interesting articles which appear on its pages.

Yours faithfully,

Sanderstead. P. C. COOPER,
Draughtsman,
Southern Railway Loco. Drawing Office.

Ciné Projector Design

DEAR SIR,—I have been actively interested in this very interesting subject, for some time. I have just completed building a dual-film sound projector to show both sound and silent 16-mm. and 9.5-mm. films, and will record some of my experiences with regard to both film movement and shutter design.

Film movement: Previous to my constructing my projector, I have had considerable experience of various types of "Home Movie" machines, and I have come to the conclusion that claw movement is not a desirable arrangement, particularly where 9.5-mm. and 16-mm. sound film are concerned, as, even with double claw, the load on film is high and a film with damaged perforations is not projected properly. Therefore, to overcome this, I used a Maltese-cross movement with intermittent sprocket, to obtain movement through the gate, and using sprocket with 12 teeth. The advantages are :—

(1) Simple film can be used. Easier to make; (2) less danger of oil contracting film; (3) Maltese and all gears can be enclosed in oil-tight case; (4) with 12-tooth sprocket, as many as six perforations can be in contact with sprocket teeth; result, less load on film and damaged film projected easily; (5) the Maltese-cross has obviously 12 points; therefore, for sound speed the sprocket shaft revolves at 2 revs. per second for 24 pictures per second. The advantage here is obvious, as 2 revs. per second equals 120 r.p.m., and since the shaft driving the Maltese-cross revolves 12 times per rev. of cross, its speed is $120 \times 12 = 1.440$ r.p.m., which allows direct coupling to a synchronous motor.

Shutter design: My arrangement is to use a two-bladed shutter revolving at 1 rev. per picture. This gives flickerless pictures at 24 pictures per second and slight flicker with silent speed of 16 pictures per second. Now, there is one point I would like to make, and that is I tried out approximately twelve different designs of shutter. but found nothing as good as the simple two-bladed type.

Mr. A. C. Jolly remarks in his letter of November 1st, 1945, that he tried out a shutter with equal openings and, of course, unequal blades and got flicker. I expect he would! I did. Before Mr. G. A. Gauld's article appeared on July 5th, 1945, I had tried out all the types he suggests and many more; but they did not reduce or help flicker. Mr. Jolly seems to have accepted the advice given therein and found it was not so. I have covered this ground and can also assure those interested that the theories expressed in Mr. Gauld's article do not work out in practice. As far as I have investigated, the only way to design a shutter to give the greatest amount of light and the least flicker possible is to proceed as follows :—Find out the minimum size of blade required to mask picture movement without ghost effect; then, if for sound films, use two blades of this size, and two equal openings. If for silent films, try to get three blades which *must be equal* and three openings which *must be equal*. If you cannot get three blades introduced for silent speed then you will have to be content with a slight flicker; but if you do not keep all openings equal and all blades equal, you will not improve the results by trying otherwise. To my mind, and from experience, the flicker-blade of smaller width than other blades, only makes matters worse. Of, course, if you can manage a three-bladed shutter for sound speed of projection, so much the better. Another point which is worth noting is this, that reducing blade area by half, say, does not mean that illumination of screen will be doubled. I do not wish to go into the theory of this, although I have studied this subject of Persistance of Visage as applied to ciné work. From references, it appears that the duration of primary image varies from 0.05 to 0.2 seconds. Those who are interested in this aspect of the subject, I would refer to *Textbook of Ophthalmology*, by W. Stewart Duke Elder, particularly Chapter XXIV—"The Physiological Effects of Stimulation," page 930.

Should further observations on projector design in general or in particular be interesting, I should be pleased to supply these if the Editor so requests.

Yours faithfully,

"EXCOGITATE."

Clubs

The Bristol Ship Model Club

The main business of the last few meetings has been connected with the forthcoming exhibition, for which some 25 models have been selected.

On December 11th the Secretary brought along his $\frac{1}{4}$ in. to 1 ft. scale model *Cutty Sark*, which created considerable interest, as well as some discussion amongst members with regard to larger scale model making, as against the more popular $\frac{1}{8}$ in. and 1/10 in. to the foot work. Some 2,500 copper plates encase the hull of this ship, which has been made to Dr. Longridge's book on the subject.

The acquisition of ships' plans, etc., being part of the objects of the club, a librarian has been appointed in the person of Mr. N. Poole, who will now have this business in hand.

Future meetings are on January 22nd and February 12th, 1946.

Anyone in the district interested should write to the Hon. Sec. and Treasurer, ARTHUR W. KITTON, 29, New Fosseway Road, Knowle, Bristol 4.

The Bristol Society of Model and Experimental Engineers

At the last meeting on Saturday, December 8th, the chairman reported that, due to pressure of business and frequent absence from Bristol, our valuable secretary has been obliged to resign.

Fortunately, Mr. C. C. Lucy agreed to fill the breach and his appointment was unanimously approved by the members present.

The pre-view of models for the forthcoming exhibition at the Bristol Museum and Art Gallery proved most interesting, and the committee were gratified at the excellent response.

Hon. Sec.: C. C. LUCY, 28, Bibury Avenue, Henlease, Bristol 9.

Nottingham Society of Model and Experimental Engineers

The recent change to two meetings each month has proved a great success. The meetings have been well attended and the talks given have aroused great interest and considerable discussion.

On January 9th, 1946, Mr. F. Day will give a talk—"Building a 2½-gauge Atlantic"; January 23rd, Mr. Chrichlow, of the Nottingham Model Yacht Club, will give an address—"Building and Sailing Model Racing Yachts."

Hon. Sec.: E. V. HODSON, 42, Priory Road, West Bridgford, Nottingham.

Merthyr Tydfil Society of Model Engineers

Efforts are being made to establish this society in the Queens Road Youth Centre. Every Friday evening from 7 to 9. A well-equipped workshop is available to all interested.

Communications to Hon. Sec., A. J. PRICE, 19, First Avenue, Salon-Uchaf, Merthyr Tydfil.

Scunthorpe Society of Model Engineers

A visit to the exhibition held by the Hull Society proved to be a thoroughly enjoyable outing, thirty members making the journey by special bus.

Members and officials of the societies at Selby, also Grimsby and Cleethorpes, were met at the exhibition, and mutual interests discussed.

Hon. Sec.: S. W. NORMAN, 14, Gervase Street, Scunthorpe.

The Kent Model Engineering Society

The following meetings have been arranged :—

January 7th.—The annual general meeting.

January 14th.—"All Alone," by Mr. Tanner.

January 21st.—Rebuilding a 1-in. scale Pacific locomotive, by Mr. T. Wattingham.

January 28th.—"Dot 4," by Mr. Sherwood.

The society will be taking possession of its new headquarters, The Alford Sports Club, Crantock Road, early in the New Year, where it will be possible once again to hold demonstrations, track runs, film shows, etc. Meanwhile, visitors are always welcome at the Davenport Hall, Catford, every Monday evening, 7.30 to 9.30 p.m. The society would like to convey to all other clubs and societies its best wishes for the New Year.

Hon. Sec.: F. H. GRAY, 3, Jutland Road, London, S.E.6.

Wicksteed Model Yacht and Power Boat Club

This club held their first dinner and re-union since 1939 at the George Hotel, Kettering, on Friday, December 7th.

In an atmosphere genial and friendly, old and new members exchanged views and experiences of the last six years. The yachtsmen of this club have been very fortunate, as, through the activities and enthusiasm of the officials, they have been able to have friendly competitions among themselves during the hard years now passed. As many as 12 boats have been competing for small trophies, most of which were presented by the commodore of the club, R. L. Whitworth. The club's measurer, L. A. Garrett, has evolved a new 10R which promises to be one of the finest boats to break water, and several members are anxious to obtain suitable wood to enable them to build new stock.

It is hoped to have a new boathouse in the Wicksteed Park, so that we shall be able to store more comfortably the 16, 10R 4 Marble heads, 4 36-in. and one or two nondescripts, not forgetting a Garrett 24-in.

The secretary, in his report concerning the future of the club, expressed the hope that contact would be made with other clubs or owners of any of the above classes with a view to arranging a few meetings next year. All visitors would be sure of a cordial reception and the amenities of the Wicksteed Park would bring pleasure to young and old.

Mr. H. Ward, who is secretary of the Power Boat Section, exhibited parts of a new 30-c.c. which aroused great interest among the many visitors, and, given suitable plywood for hulls, he promised to put this engine and those of others, to the final and exacting test at the end of a central anchored line.

A good dinner was enjoyed by all, and there promises to be great activities during 1946.

Hon. Sec.: J. G. SKEWS, 3, Lyveden Place, Kettering.

The Tonbridge and District Model and Experimental Engineering Society

On Saturday, December 1st, Mr. R. J. Raymond, Editor of *The Model Railway Constructor*, paid a very welcome return visit to the society's meeting and gave a talk entitled "Current Affairs."

He dealt first with the work of the societies he knew, and gave some sound advice on the conduct of societies' affairs, the difficulties to be expected and surmounted, and the hopeful future to which we could look forward.

He then turned to the subject of present-day railway practice. Progress had, in general, ceased on the outbreak of the war, and only now were the main-line companies beginning to prepare and execute improvements to rolling stock, track and timings. He showed some interesting booklets produced by two of the companies, in which travellers were asked for their ideas on details that make such a difference to travellers' comfort, the inference being that improvements desired by the majority would be, in due course, incorporated in carriage design.

An interesting show of models made by members of the society was displayed in the window of the *Tonbridge Free Press*, by courtesy of the Editor, from December 8th to 29th.

Hon. Sec.: A. R. JUDD, 13, Mountfield Park, Tonbridge.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Maidenhead, Berks.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," Cordwallis Works, Maidenhead, Berks.

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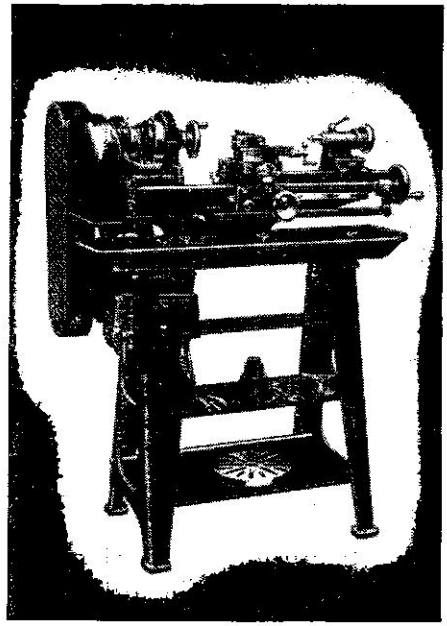

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